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ABSTRACT

Intended primarily for use by individuals about to assume responsibility for the implementation of field trials and demonstration projects built around interactive telecommunication systems, this report provides brief descriptions of 20 telemedicine projects, 12 teleconferencing projects, and seven involving two-way applications of cable television; three case studies providing fuller descriptions of the Nursing Home Telemedicine Project in Boston, Massachusetts, the Educational Telephone Network at the University of Wisconsin-Extension, and the Peoria Interactive Cable Television Project; and discussions based on the findings of this study including research context and objectives, needs assessment and project planning, system installation, users, implementation process management, and conclusions reached. A bibliography of 35 items is attached. (CHC)

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IMPLEMENTING INTERACTIVE TELECOMMUNICATIONS SERVICES

Final Report on Problems Which Arise During Implementation of Field Trials and Demonstration Projects

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CONTENTS

PREFACE iii

CHAPTER 1
Introduction 1

CHAPTER 2
Glossary of Projects 5

Case Studies

CHAPTER 3
The Nursing Home Telemedicine Project in Boston, Massachusetts 13

CHAPTER 4
The Educational Telephone Network at the University of Wisconsin-Extension 25

CHAPTER 5
Peoria Interactive Cable Television Project . . . 34

General Findings

CHAPTER 6
Research Context and Objectives 41

CHAPTER 7
Needs Assessment and Project Planning 48

CHAPTER 8
Installing the System 59

CHAPTER 9
Users 69

CHAPTER 10
Management of the Implementation Process 81

CHAPTER 11
Conclusion 91

REFERENCES 96

PREFACE

This report draws upon experience, insight, and analysis most generously provided by a great number of people: those who had conducted the projects we chose to review; those who commented upon an earlier working paper; strategically located federal officials who responded to our requests for information and various members of the telecommunications and other research communities. We do not acknowledge them individually only because a list of more than one hundred names would be indigestible and it would be unfair to single out a few. Our colleagues Red Burns, Eileen Connell, and Ben Park made substantial contributions to this study, as did Bob Johansen, Dick Orr, Marty Robbins, and Percy Tannenbaum who acted as consultants.

The project was funded by the National Science Foundation under grant number APR-77-18697. We are most grateful for the interest and support of Dr. Charles Brownstein as program manager. Responsibility for any shortcomings in the project and for the interpretation offered in this report rests solely with the authors.

CHAPTER ONE

Introduction

Introducing a new telecommunication system is a much more complex and difficult undertaking than is generally acknowledged in the report literature. Indeed, project reports very rarely discuss the problems which were encountered during the implementation of field trials and demonstration projects.

Lack of appreciation for such difficulties is doubly unfortunate. On the part of initiators of field trials and their sponsors, it makes failure more likely. On the part of outside observers, it makes it harder to understand past patterns of success and failure.

This report treats problems arising in the implementation of field trials and demonstration projects built around interactive telecommunication systems. It is intended, primarily, for individuals who are about to assume responsibility for the implementation of such projects. For this reason, it emphasizes those practical issues and problems which a manager is likely to encounter in getting a field trial or demonstration project up and going. The secondary audience for the report includes policymakers and researchers who are concerned with implementation problems because they may influence research findings; inform policy decisions; and/or prevent good research and policy studies from ever taking place.

6

The purpose of our study was to learn from the implementation of past projects and to synthesize findings in a way which would be useful to future projects. It was not our purpose to conduct a critical evaluation. (Occasionally, in our analysis, it was helpful to distinguish between projects which were, and were not, successfully implemented. In such cases our criterion was whether the process of implementation was considered a success by the initiators of the project in question.)

Findings are based on a review of approximately 45 U.S. based interactive telecommunications projects. Most were field trials and demonstration projects, although a few others were added for purposes of comparison.[1] Chapter Two of this report, titled Glossary of Projects, provides a list of the projects, together with a few basic facts about each.

The projects to which we directed our study fell into three groups, generally referred to as telemedicine, teleconferencing, and two-way applications of cable television. The descriptors are reasonable in that they identify clusters which have a clear meaning to most people who are working in the field. They are, however, unsuitable for classificatory purposes since they are of different logical types. Many projects would be listed under more than one heading. Telemedicine refers primarily to the activity which generates a need for communication, i.e., delivery of health care. Existing telemedicine projects employ a variety of interactive media to deliver health care and provide training.

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[1]For example, the Dow Chemical, ERDA, First National City Bank, and GSA teleconferencing services and the Irvine Two-Way Cable Project were intended only to meet needs arising in a service context.

Teleconferencing refers to the use to which the telecommunication system is put, i.e., discussion among three or more people at two or more locations. Teleconferencing may involve educational, administrative, sales or other activities and it, too, may be conducted through a variety of interactive media.

As it suggests, the term two-way applications of cable television refers to the means by which the communication is transmitted. The applications may arise in the delivery of health care, educational, legal, or other services.

Since the term implementation is used differently in different fields, our own usage may require clarification. We refer to the process which starts with the outline design of a telecommunication field trial or demonstration project (such as is typically found in a proposal for funding) and continues through the more detailed design, installation, and modification of the technical system, ending when utilization of the system is sufficient to meet the project's objectives (or when the project is abandoned). In this sense, implementation is a broadly defined, multi-phased process encompassing social, technical, and organizational aspects. The implementation period may vary from several weeks to a few years.

We use the term system in several ways: referring to the technical system; to the larger system which also includes the people using the equipment to provide a service; and to the organizational or community systems of which interdependent groups of users are the components. We use the term service in referring both to the communications service made possibly by the telecommunication system and the higher level service, e.g., health care, which generates the need for communication. The context will make the particular usage of system or service clear.

Specitic sources of intormation for our study were as tollows: (1) research papers and other reports issuing from the projects in our sample; (2) face-to-face meetings with project managers and other staff at more than 50% of the projects mentioned in the Glossary; (3) a questionnaire to all the projects (over 70% responded); (4) written and verbal reactions to a working paper issued halfway through the project; (5) the research literature in this and closely related fields, and; (6) meetings with consultants to our project. The gathering of data was terminated in the summer of 1978. Results of the study have already been widely disseminated, particularly through an earlier working paper[2] and a draft of this final report printed in October 1979.

This report is presented in narrative form to make it as readable as possible. Supporting evidence, further discussion of some theoretical points, citations from research literature, and comments by readers about the earlier working paper are presented in a forthcoming supplement which is written as a commentary upon this report.

It will probably be useful for us to provide some readers with fuller descriptions of a few projects, so as to illustrate the contexts within which implementation issues arise. Chapters Three, Four, and Five each provide one such case study. These three studies are not intended to be representative; there is no way that such a small number could be. No significance should be read into the fact that administrative teleconferencing is omitted; nor into the fact that the two-way television application was abandoned, while the two audio applications were successful.

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[2]Interactive Telecommunication Systems: A Working Paper on Implementation Problems, Martin Elton and John Carey, The Alternate Media Center, February 1978.

CHAPTER TWO

Glossary of Projects

The projects on which our study drew are listed below in alphabetical order by state or region.

Telemedicine

1. Alaska ATS-6 Health Care Delivery Demonstration. Multi-site, interactive television via satellite for the delivery of health services and training. Information Contact: Martha Wilson, M.D., Alaska Area Native Health Service, P.O. Box 7-741, Anchorage, Alaska 99510.
2. Veterans Administration ATS-6 Health Care Experiment in Appalachia. Multi-site, interactive television via satellite for the delivery of health services, grand rounds, and computer-assisted instruction. Information Contact: Robert Shamaskin, Learning Resources Service, Veterans Administration, 810 Vermont Avenue, Washington, D.C. 20420.
3. STARPAHC, Space Technology Applied to Rural Papago Advanced Health Care, Tucson, Arizona. Multi-site (including a mobile unit) interactive television via microwave for the delivery of health care. Information Contact: James W. Justice, M.D., Medical Director, U.S. Public Health Service, Indian Health Service, Tucson, Arizona 85726.
4. Dade County Prison Medical Service, Dade County, Florida. Multi-site interactive television, slowscan

television and audio links via microwave for the delivery of health care to a prison population. Information Contact: Jay H. Sanders, M.D., University of Miami School of Medicine, Coral Gables, Florida 33125.

5. Jacksonville Telemedicine Network, Jacksonville, Florida. Multi-site interactive television via microwave for the delivery of health care. Information Contact: Samuel Rowley, M.D., Director, Duval County Health Department, Jacksonville, Florida 32202.
6. Garfield-Bethany Brethren Hospitals, Chicago, Illinois. Multi-site Picturephone® interaction for medical consultation, conferencing, and transmission of medical records. Information Contact: Dr. Vernon Showalter, Bethany Brethren Hospital, 3420 West Van Buren Street, Chicago, Illinois 60624.
7. Cook County Hospital, Department of Urology Picturephone® Network. Multi-site picture telephone interaction for the improvement of health care and administrative information exchange. Information Contact: Irving Bush, M.D., Department of Urology, Cook County Hospital, 1825 West Harrison Street, Chicago, Illinois 60612.
8. Illinois Department of Mental Health Network, Chicago, Illinois. Multi-site picture telephone interaction for psychiatric consultation and treatment and the exchange of medical information. Information Contact: William Lewis, Coordinator, Administrative Services, Illinois State Psychiatric Institute, 1601 W. Taylor Street, Chicago, Illinois 60612.
9. Blue Hill-Deer Isle Interactive Television Project, Blue Hill, Maine. Two-site interactive television via microwave for the delivery of health care and medical training. Information Contact: Richard Britt, M.D.,

Blue Hill Memorial Hospital, Blue Hill, Maine 04614.

10. Interactive Telecommunication System for Central Maine. Multi-site interactive television via microwave for the delivery of health care and medical education. Information Contact: Robert Cowan, Medical Care Development, Inc., 295 Water Street, Augusta, Maine 04330.

11. Rural Health Associates, Interactive Medical Microwave Television, Farmington, Maine. Multi-site interactive television via microwave for the delivery of health care, medical education, and personal support for medical personnel in a dispersed rural practice. Information Contact: David C. Dixon, M.D., Rural Health Associates, Farmington, Maine 04938.

12. Massachusetts General Hospital Telemedicine Project, Boston, Massachusetts. Multi-site interactive television via microwave for the delivery of health care and medical training. Information Contact: Kenneth T. Bird, M.D., Medical Station, Tower Building, Logan International Airport, Boston, Massachusetts 02128.

13. Nursing Home Telemedicine Project, Boston, Massachusetts. Multi-site telephone interaction (voice and telemetry) for the delivery of health care. Information Contact: Dr. Roger Mark, Department of Electrical Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139.

14. Cambridge Telemedicine Project, Cambridge, Massachusetts. Multi-site interactive television set up for purposes of comparison with an ordinary telephone in the delivery of health care to neighborhood clinics. Information Contact: Gordon T. Moore, M.D., Cambridge Telemedicine Project, Cambridge Hospital, 1493 Cambridge Street, Cambridge, Massachusetts 02139.

15. Lakeview Clinic Bi-Directional Cable Television System, Waconia, Minnesota. Multi-site interactive television via cable for the delivery of health care and medical training. Information Contact: Jon Wempner, M.D., Lakeview Clinic Group, 609 West First, Waconia, Minnesota 55387.

16. Nebraska Veterans Administration Network, Omaha, Nebraska. Multi-site interactive television via microwave for the delivery of medical and psychiatric care, medical and non-medical education, and for staff coordination. Informaton Contact: William F. Gust, M.D., Assoc. Chief of Staff for Education, Omaha Veterans Administration Hospital, Omaha, Nebraska 68501.

17. Interact, New Hampshire/Vermont Medical Interactive Television Network, Hanover, New Hampshire. Multi-site interactive television via microwave for medical consultation and teaching, non-medical education, and conferencing. Information Contact: Marshall Krumpe, Director, Interact, Dartmouth Medical School, Department of Community Medicine, Hanover, New Hampshire 03755.

18. Mount Sinai-Wagner Bi-Directional Cable Project, New York, New York. Two-site interactive television via cable for the delivery of pediatric services to an inner city neighborhood. Information Contact: Carter L. Marshall, M.D., Director, Office of Primary Health Care Education, New Jersey Medical School, 100 Bergen Street, Newark, N.J. 07103.

19. Case-Western Reserve Telemedicine Project, Cleveland, Ohio. Two-site interactive television via laser and cable for the delivery of anesthesiological care. Information Contact: J.S. Gravenstein, M.D., Director, Department of Anesthesiology, School of Medicine, Case-

Western University, 2040 Adelbert Road, Cleveland, Ohio 44106.

20. Ohio Valley Medical Microwave Television System, Columbus, Ohio. Multi-site interactive television via microwave for the delivery of medical and psychiatric care, administrative communication and medical training to Ohio's Appalachian Region. Information Contact: Ronald A. Black, Director, Ohio Valley Medical Microwave Television System, 353 Grosvenor Hall, Athens, Ohio 45701.

Teleconferencing

1. Dow Chemical Co., Video Conferencing, Midland, Michigan and Freeport, Texas. Two-site video-conferencing between Dow headquarters and one Dow facility via full 4.5 MHz television lines. Information Contact: Gordon Lee, Commercial Marketing Division, Dow Chemical Company, 2020 Dow Center, Midland, Michigan 48640.
2. Educational Telephone Network, Madison, Wisconsin. Multi-site (over 200 locations) audio-conferencing for education via dedicated telephone lines. Some sites can send and receive electro-writer graphics. Information Contact: Dr. Lorne Parker, University of Wisconsin-Extension, 975 Observatory Drive, Madison, Wisconsin 53706.
3. Electronic Information Exchange System (EIES). Multi-project, computer conferencing developed and administered by the New Jersey Institute of Technology. Information Contact: Dr. Murray Turoff, New Jersey Institute of Technology, 367 High Street, Newark, New Jersey 07102.
4. ERDA Visual Conferencing Service. Two-site video-conferencing via microwave between U.S. Department of

Energy headquarters in Washington, D.C. and Germantown, Maryland. Information Contact: Mr. Robert Lewis, ERDA Visual Conferencing Service, U.S. Department of Energy, Germantown, Maryland 20767.

5. First National City Bank Video Conferencing. Two-site video-conferencing via microwave between bank branches in New York City. Information Contact: Mr. Theodore Waneski, Audio Visual Service, First National City Bank, 339 Park Avenue (36th Floor), New York, N.Y. 10016.

6. General Services Administration Teleconferencing. Multi-site audio-conferencing, via telephone lines at GSA regional locations throughout the U.S. Information Contact: Mr. W.F. Mulhall, Jr., Chief of Marketing Branch (CPSM), General Services Administration, 18th & F Street N.W. (Room 1227), Washington, D.C. 20405.

7. National Aeronautics and Space Administration Teleconferencing. Multi-site audio-conferencing via telephone lines at regional locations throughout the U.S. Information Contact: Mr. Samuel Fordyce, NASA Teleconferencing Project, NASA Headquarters, Washington, D.C. 20546.

8. New York Metropolitan Regional Council (MRCTV). Multi-site interactive television via microwave for education and conferencing by government employees. Information Contact: Ms. Mary Harris, President, New York Metropolitan Regional Council TV Network, 1 World Trade Center (Room 2437), New York, New York 10048.

9. Phoenix Criminal Justice System Picturephone® Project. Multi-site interactive television via picture telephone for inmate consultations with public defenders, remote testimony and administrative information exchange. Information Contact: Mr. Robert Carlburg, Court Administrator's Office, 101 West Jefferson Street, Superior Court Building, Phoenix, Arizona 85003.

10. Picturephone® Meeting Service. Multi-site, public video-conferencing (commercial television bandwidth) provided by the Bell System for business meetings and other applications as determined by the individual user. Information Contact: Mr. Norman Weber, Manager, Teleconferencing Services, AT&T, Basking Ridge, New Jersey 07920.

11. Planet. Multi-site computer conferencing developed and administered as a trial service by the Institute for the Future, Palo Alto, California. (Now a commercial service offered by another company.) Information Contact: Dr. Robert Johansen, Institute for the Future, 2740 Sand Hill Road, Menlo Park, California 94025.

12. Union Trust Company Audio Conferencing. Two-site audio-conferencing via 5 KHz simplex lines (later changed to 3 KHz duplex lines) between bank branches in Stamford and New Haven, Connecticut. Information Contact: Mr. Joseph Tomey, Union Trust Company, 579 Bennett's Farm Road, Ridgefield, Connecticut 06877.

Two-Way Applications of Cable Television

1. Irvine Elementary Schools Two-Way Television System. Multi-site interactive television via cable for inter-school educational and recreational activities. Information Contact: Professor Mitsaru Kataoka, Dickson Video Arts Laboratory, University of California at Los Angeles, Los Angeles, California 20024.

2. Peoria Cable Television Project. Multi-site interactive television via cable for education of the handicapped in their homes. Information Contact: Cable Television Information Center, 2100 M Street N.W., Washington, D.C. 20037.

3. Rockford Cable Project. Multi-site interactive television via cable for training firemen and teachers. Information Contacts: (re: firemen training) Dr. Thomas Baldwin, Department of Radio and Television, 322 Union Building, Michigan State University, Lansing, Michigan 48824; (re: teacher training) Dr. F. Gerald Klein, School of Journalism and Mass Communication, University of Minnesota, Minneapolis, Minnesota 55455.

4. Project Tel-Catch, Amherst, New York. Multi-site interactive television (downstream video via cable; upstream data via telephone line) for education of the handicapped in their homes. Information Contact: Dr. James C. Marillo, Project Tel-Catch, 55 Elk Street (Rm. 215), Albany, New York 12234.

5. Philadelphia Police Department Two-Way Cable Television. Multi-site interactive television via dedicated cable network for pre-arraignment hearings, training of police officers, exchange of information, and other police work. Information Contact: Mr. Joseph Paglia, Administrative Analysis Division Supervisor, Police Headquarters, Franklin Square, Philadelphia, Pennsylvania 19106.

6. Reading Two-Way Cable Television. Multi-site interactive television via cable for the exchange of community information and delivery of social service information to senior citizens. Information Contact: Ms. Red Burns, Alternate Media Center, New York University, 144 Bleecker Street, New York, New York 10012.

7. Spartanburg Interactive Cable Television Experiment. Multi-site interactive television for home-based education, training of day care workers and delivery of social service information to senior citizens. Information Contact: Dr. William Lucas, National Telecommunications and Information Administration, 1325 G Street N.W., Washington, D.C. 20504.

CHAPTER THREE

The Nursing Home Telemedicine Project in Boston, Massachusetts

The Nursing Home Telemedicine project was based at Boston City Hospital, Boston, Massachusetts. It involved the modest use of narrowband telecommunications (principally, ordinary telephones and simple medical tests, the results of which could be transmitted over telephone lines) within a radically reorganized system for the delivery of health care. It was sponsored principally by the National Science Foundation and was designed as a statistically rigorous field experiment. In research terms, it was decidedly successful: statistically significant results were obtained to confirm hypotheses that the effectiveness of the delivery system would be improved and that overall costs would be reduced. (Thus, the need to consider "trade-offs" between these variables was avoided.) It has been successful in another sense too, in that it successfully made the transition from its field trial status and has been a regular operational system since 1975. While it has not yet been imitated elsewhere, so far as we know, it has almost certainly been instrumental in the noticeable recent shift in attention from broadband to narrowband telecommunications within the health care arena.

3.1 Concept

The innovation was directed toward the difficulty that many nursing homes experience in obtaining adequate medical

supervision for their patients. This results in a widespread use of hospital out-patient departments and emergency wards. It necessitates heavy utilization of expensive ambulance services and causes discontinuity of care.

The trial system comprised a team of specially trained nurse practitioners, supervised by a hospital-based physician, using the regular telephone together with certain devices which could be attached to the telephone network.

The concept was developed and the project led by Dr. Roger G. Mark, someone who was unusually well qualified for work in telemedicine: a practicing internist (now at Boston's Beth Israel Hospital) and a member of the faculty of electrical engineering at MIT.

3.2 Preliminary Studies.

By the time the NSF-funded field trial started in 1973, there had already been two to three years of separately funded preparatory work. In 1971, the Massachusetts Department of Public Health had provided a $7,000 grant for initial planning. In 1972, the Tri-State Regional Medical Program had provided $25,000 for the training of an initial group of nurse practitioners and for a one-year pilot program. The latter also received supplementary funding of $10,000 from the Medical Foundation. Nor was the financial transition from the preliminary studies to the field trial entirely straightforward. The approach to NSF was only made after difficulties arose concerning anticipated funding from HEW.

It is worth emphasizing that the preliminary planning lasted longer than the field trial. The funding noted above amounts to about 15% of the later grant from NSF (noted by Shinn [1978] to be less than $300,000); and this substantially understates the pre-trial costs since it omits the two nursing positions which Boston City Hospital's Department of Nursing provided for the pilot year.

Three major preliminary activities may be noted:

1. Initial program planning, started in 1971.
2. Training of an initial group of nurse practitioners, started in 1971.
3. A twelve-month pilot study with two nurse practitioners and two part-time physicians, started in June 1972.

The pilot project demonstrated the feasibility of the envisaged system and reinforced impressions concerning its potential advantages. Shinn states: "The innovation was clearly specified, and it did not change during the experiment. Enough prior work had been done so that it was generally believed that the organization and technology were pretty well optimized, so there were no significant pressures to improve or change either of them during the experimental period" (Shinn, 1978).

3.3 Design of the System[3]

The telemedicine system used in the trial may be described in terms of its actors, its communications sub-system, and its operating principles. Changes which took place after the trial will be noted later.

The health care team was led by a hospital based medical director, a physician fully trained in internal medicine. He had prime clinical responsibility for all patients under the care of the program. Additional coverage at nights and weekends was provided by part-time internists.

The team also included four nurse practitioners--individuals with extensive prior experience in adult and geriatric nursing who had taken specialized advanced training and who also received several months of on-the-job training.

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[3]This subsection contains lengthy, almost verbatim extracts from the Final Report to NSF (Mark et al., 1976).

The patients were certain individuals entering or returning into the care of those nursing homes designated as the "treatment group." There were two routes into the system: discharge from Boston City Hospital, the main route, and referral by the Director of Nursing at the nursing home, if the patient was being admitted from home or from some institution other than BCH. Whenever the patient or the patient's family requested continuing medical care through the telemedicine team, following discussion of the program, he or she was accepted into the program.

Other than manual records, there were two major elements in the team's (internal) communications subsystem: clinical conferences at the hospital on Wednesdays and the regular telephone. (Regarding the latter, it may be noted that the nurse practitioners were well trained and known personally to the physicians; the patients also were well known; and the majority of decisions related to the follow-up of chronic disease or the management of common acute illness.) In addition, there were telephone-coupled facsimile transceivers for the transmission of EKGs, progress notes, doctor's orders, and prescriptions; a tone and voice paging system to assure availability of a physician; portable EKG machines; and telephone-coupled transmitters for analysis of the functioning of pacemakers. A color Polaroid camera was used occasionally to obtain a non-emergency subspecialty consultation (in dermatology, for example) without transporting the patient. Certain of these components found not to be cost-effective were eliminated later.

The telemedicine team provided 24-hour-per-day, seven-day-per-week coverage with one physician on call at all times to respond to emergencies. Basic operating principles were as follows. After the patient's transfer to the nursing home, a complete medical evaluation was performed by both the nurse practitioner and, later, by the physician. A patient

record was established, and a care plan and follow-up visiting schedule determined. Duplicate records were maintained at the hospital base as a reference for team members.

The nurse practitioner visited each patient at intervals which depended upon the individual patient's clinical status and treatment plan. Thus, some patients were seen up to several times per week, while others were seen at monthly or longer intervals. (Maximum intervals between visits are set by regulation--one month for level 2 and three months for level 3.) Follow-up examinations generally consisted of obtaining pertinent medical data by means of an interval history, a physical examination, and laboratory tests. Acute illnesses, accidents, and other emergencies were evaluated initially by the nurse practitioners. Such "unscheduled visits" comprised about one-third of all visits. For many of the more common problems (heart failure, diabetes, urinary tract infections, pneumonia, chronic lung disease, stroke, etc.), protocols were developed to guide but not restrict the nurse practitioners.

Medical data were recorded by the nurse practitioner in the usual problem-oriented format as progress notes. On the basis of her knowledge of the patient, and the current medical observations, the nurse practitioner had to make certain decisions as outlined in Figure 3.1. She had to decide in each case whether or not a physician consultation was needed and if so, what its urgency was. If no physician consultation were needed, one carbon copy of the progress note was returned to the hospital office and entered into the patient's record. Before such notes were filed they were reviewed by the responsible physician. Certain "low priority" management problems could be deferred for

discussion at weekly clinical conferences in which the entire health care team participated.

If the nurse felt the problem was sufficiently serious to warrant a physician's intervention, a telephone consultation ensued. On the basis of the information transmitted, the physician either instituted an appropriate change of orders via telephone or elected to evaluate the patient directly in the nursing home. When the information transmitted in the consultation indicated an emergency situation, the physician then arranged for an immediate admission to the hospital.

It should be added that the nurse practitioners also undertook some education of nursing home staff during their visits.

3.4 Research Design

The project lent itself to a strong experimental design: it was possible to select an appropriate control group and to obtain meaningful measures of effectiveness and cost. The 95 nursing homes served by BCH's Continuing Care Unit were stratified on the basis of objective and subjective variables into 11 sub-groups. Within each stratum, nursing homes were randomly allocated to treatment or control status. It was then necessary to negotiate the participation of the nursing homes in the study; those assigned to the "treatment group" were more easily recruited because they stood to gain medical care coverage. In all, 13 homes were recruited for the "treatment group" and 11 for the control group. Self-selection may have caused a bias but none was obvious in terms of size and ownership variables. While those homes which perceived a genuine need to improve their medical care could be expected to be more eager to participate, the resulting bias would work to the disadvantage of the

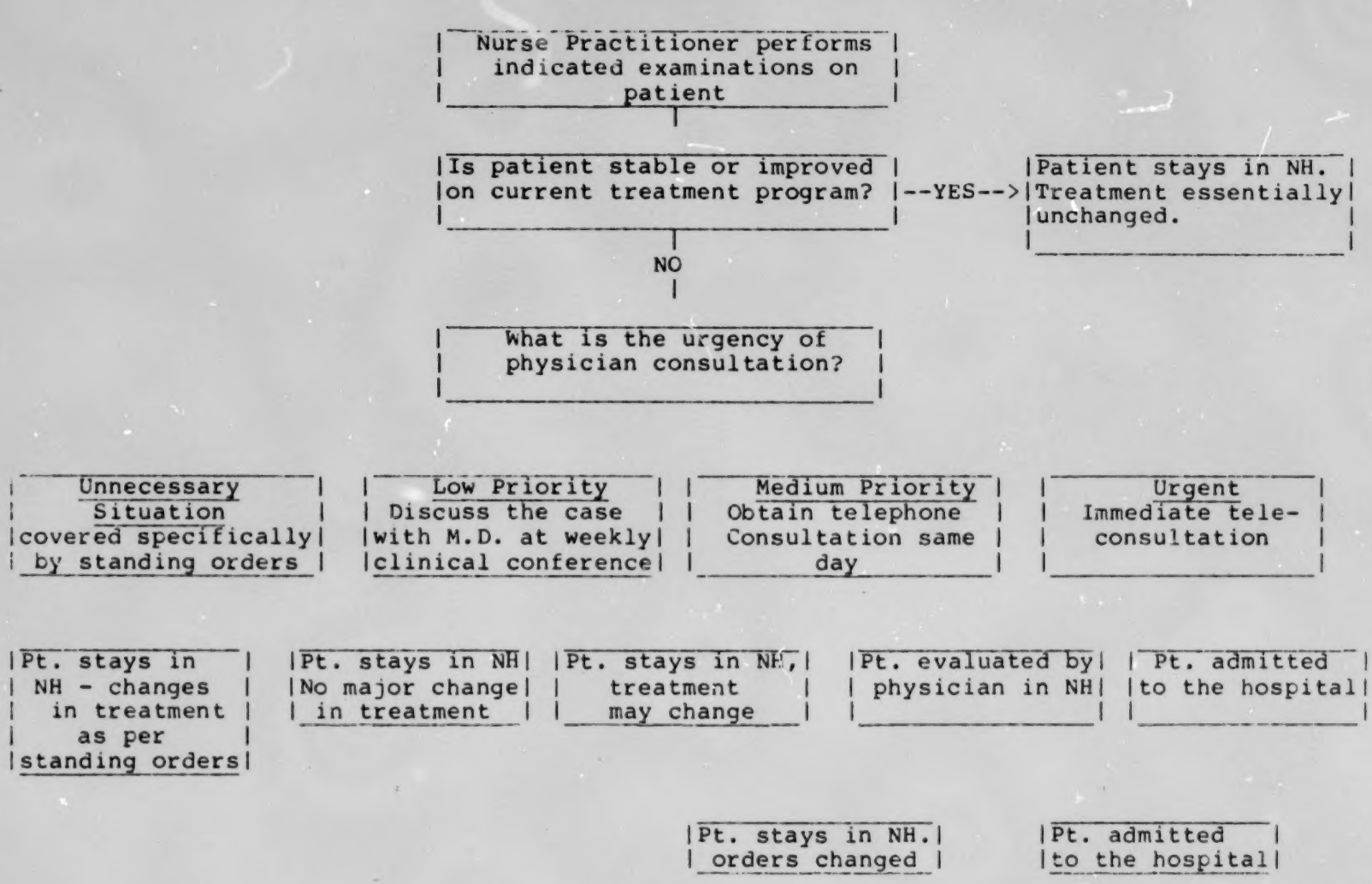

Figure 3.1. Decision matrix (from Mark et al., 1976).

innovation, thus, it would not endanger the validity of positive findings.

It was also necessary to select patients within the two groups. The selection of the telemedicine patients was described in the preceding sub-section. In addition, a few other patients with particularly difficult management problems were accepted at the request of the nursing home or the patient's family. Patients in nursing homes in the control group were accepted into the patient control group if they had been discharged from BCH, if they had received follow-up care at its clinics or emergency ward, or if it appeared likely they would make use of its facilities.

Measures were developed and data gathering systems were set up to cover both quality of care and costs. Both outcome measures (e.g., hospitalization, change in functional disability level, mortality) and process measures (e.g., visit interval distributions) were used in relation to quality of care. In addition, subjective assessments of the trial program were obtained by an outside group from a wide cross-section of health professionals in the nursing homes, the hospital, and the community.

Finally, the study was designed to document operational characteristics such as staffing requirements and technology utilization. A computer simulation model was developed and used to explore variations on the basic design.

3.5 Problems During the Project

Problems experienced during the field trial were few and not particularly severe. In this connection one may note:

1. The technology placed no serious demands on its users, was reliable, and posed neither installation nor accommodation problems.
2. There was a separately funded planning study which included a pilot project.
3. The research design did not contlict with service delivery objectives.
4. The service delivery component of the project team comprised only a few people. As an "organization" it was specially formed for the project.
5. Proper provision was made for the training of the nurse practitioners in their new jobs. (Six to nine months on-the-job training was required following specialized advanced training.)

Most of the problems which did arise related to the demands of the research design. One concerned the requirement that the study and control populations be identical--often a difficulty in real-world experiments. Another relatively common problem was incompleteness of data: the full requirements were too much for the nursing home staff to meet.

The project also encountered a slower than anticipated build-up of study patients. Three reasons were advanced for this; two resulted from "environmental" changes early in the project and one from the threat which the trial posed to "outside" actors. A policy decision by the city substantially reduced the occupancy of the hospital, hence the number of patients it discharged to nursing homes. There was also a sharp reduction in the use of its out-patient clinics following a change in Massachusetts Medicaid reimbursement policy for ambulance transportation.

Finally, there were the reactions of the community physicians threatened with the loss of patients: they showed a considerable reluctance to permit transfer of their

patients, even if this was suggested by nursing staff in the homes, and they may have been reluctant to use Boston City Hospital for fear of subsequently losing control of their patients. The short-fall, however, imperilled neither the statistical validity of the trial nor the economic viability it sought to demonstrate.

3.6 Operation of the Innovation

The telephone was entirely satisfactory for communication between the nurse practitioner and the physician. On the average, nurses spent 2 1/2% of their time in such communication (excluding Wednesdays when there were regular conferences); they were able to handle 90% of all patient visits without intervention by the physician in person or by telephone.

The portable EKG machines proved indispensible and the number was increased to allow one per nurse practitioner. Usage of the rented facsimile equipment was low, however, and it was removed at the end of the trial. Use of the Polaroid camera was also given up.

It was determined that the maximum caseload a nurse practitioner could effectively assume was 125 patients. There was, however, some variability between nurses in this respect and it took almost a year for this level of productivity to be attained.

3.7 Transition to a Regular Operating Basis

Results of the trial were successful. Statistically significant improvements in care with simultaneous reductions in cost were demonstrated. (These savings resulted primarily from decreased utilization of hospital in-patient services.) It was demonstrated that the program would be self-supporting at a reasonable rate of reimbursement for the services of the nurse practitioners and physician assistants. (Both types of health professional are now employed in the program.) It is the Federal Medicare Program which normally funds both

physicians' services in nursing homes and in-patient hospital costs; savings of more than $600 per nursing home patient-year would have accrued to it. As a matter of policy, however, it would not reimburse services provided by nurse practitioners or physician assistants.

Fortunately, the Massachusetts Medicaid Program and the Massachusetts Rate-Setting Commission agreed to fund the program for its patients. (These represented a majority of the telemedicine patients.) The reimbursement rate is $20 per visit and at this level the program is just about able to pay its way.

There was significant turnover of staff at the end of the grant period and some physician assistants were recruited to the team. Seemingly, they are as effective as the nurse practitioners. Productivity, defined in terms of visits per patient-month, was approximately the same during the 1 1/4 years following the trial as during it. (The inference about relative productivity implicitly assumes a constant average caseload.)

Difficulty was experienced, however, in integrating the program into the existing clinical structures at Boston City Hospital. The primary reason was unwillingness of hospital-based physicians to assume the added responsibilities of caring for nursing home patients. The biggest objections were the need for night and weekend coverage and the requirement to make personal visits to the nursing homes. It appeared that the physicians who chose to work in hospital clinics or neighborhood health centers were unwilling to go outside the walls or to work more than 35 hours a week.

Hence, the nursing home program fits much better into a group practice setting where night and holiday coverage and "home calls" are accepted responsibilities. A varied clinical experience for all team members is important--ideally no more than about 50% of time should be spent on

work relating to nursing homes. A continued close association with a hospital is of course important.

At present, the program is imbedded in a somewhat experimental group practice which relates to the Beth Israel Hospital. The practice focuses specifically on inner city patients, particularly the elderly, chronically ill, homebound and those confined to nursing homes. The nursing home program comprises about one-third to one-half the total work. The project continues to go well.

CHAPTER FOUR

The Educational Telephone Network at the University of Wisconsin-Extension

The Educational Telephone Network at the University of Wisconsin-Extension, which started in 1965, uses dedicated telephone lines to bring interactive audio instruction to more than 33,000 students each year. Students take the telemediated courses at some 200 locations throughout the state of Wisconsin. Since 1969, the Educational Telephone Network (ETN) has been supplemented by a sister network, the Statewide Extension Education Network (SEEN) which utilizes a dedicated telephone network to provide interactive audio instruction plus simple graphics (whatever the instructor writes on a pad is seen by the students), primarily for engineering and business courses. Together, they form the largest and most sophisticated telephone-based educational delivery system in the United States.

4.1 Early History

The Educational Telephone Network grew out of an existing extension program at the University of Wisconsin. It was preceded by several small scale uses of teleconferencing by the university extension program over a period of three or four years. The telephone network, as originally set up, had 18 sites. It was intended to be an operational system from the very beginning, and all of the major figures in the implementation and continuing management of the system have been employed by the University of

Wisconsin-Extension. The purpose of the telephone network was to meet a very practical need for continuing education in areas of the state which were not close to campuses.

There were a number of problems in the early operation of the system, particularly in the first year. In order to maintain good audio quality, special help from the state telephone company had to be negotiated (transmission quality in the first year was poor). Also, state-of-the-art teleconferencing equipment in 1965 was primitive. And instructors who used the system tended to adopt a lecture format which was not suited to interactive audio teaching (little was known about effective formats for such a system). The university responded to the transmission line problem by inviting a major figure from the state telephone company to participate on a university advisory board and by negotiating for a special advisory committee within the state telephone company to assist in maintaining good audio quality throughout the transmission network.

Its response to the second problem (poor state-of-the-art equipment), was to design an audio conferencing unit and then to seek out a manufacturer (the Darome Company) and develop the unit jointly. To help improve instructors' styles of presentation, it developed a series of booklets and brochures (later, audio and video training tapes) with very practical, straightforward tips on how to use the system effectively. These training materials have evolved over time on the basis of information provided by ETN staff, surveys of students, and in-house research on format effectiveness.

An important aspect of the early history of the Educational Telephone Network was a management style of bringing into the system all of the groups and agencies which could affect their survivial. They formed an advisory committee with representatives from each of the state's extension districts, relevant university departments, and

user groups (e.g., agriculture, pharmacy, county extension agents). This advisory committee, the Anderson Committee, helped set a number of important policies (e.g., they recommended that a local program administrator should be responsible for each site and that the district director would provide overall supervision for operations within that district). The Anderson Committee also brought knowledge to the implementation team about situations and groups with whom they had to deal and provided entrees to some of these groups.

4.2 The Current System

The Educational Telephone Network is a dedicated four-wire network which means, simply, that audio quality is better than the regular telephone network and that the telephone lines are used exclusively by ETN. Its sister network, (SEEN), with graphics capability, uses two dedicated, four-wire networks. Voice signals are transmitted over one network while the second network simultaneously transmits the graphics signals.

The central studio and control complex for ETN/SEEN are located at the Madison campus of the university. However, a number of programs originate from other campuses and ETN/SEEN sites, as well as from beyond Wisonsin's borders. A trained engineer handles technical aspects of the system at all times, so instructors are free to concentrate on their presentations. In addition, a range of facilities within the Madison complex (e.g., the U-Tape-It Studio) are designed to be easy to use. Many faculty take advantage of these facilities to tape interviews with visiting experts and do other production work.

Students participate in a course by going to a room (which may be in a courthouse, school, hospital or other public building) at some 200 locations throughout the state. A wall outlet in the room connects it to the telephone

network. No dialing is necessary--the network is always "on." The local program administrator plugs in a standard teleconferencing unit (the Darome "Convener"). It consists of a loudspeaker and four desk microphones which have long cords and can be easily moved.

In a typical class, the instructor speaks to students and they respond or ask questions by pressing a bar on the microphone and talking. In some cases, the instructor plays a prerecorded tape first, which is followed by live discussion with the class. Class size ranges from 3 or 4 in a specialized course to more than 1,000 in one instance. A typical class consists of approximately 75 students spread out among 35 locations. Any number of the 200 locations throughout the state can participate simultaneously in ETN. SEEN, the visual network, is available at 23 sites.

Most courses are not for credit (approximately 5% offer credit). Course offerings consist of updating job skills for professionals, general continuing education, and hobby related courses such as photography. A specific attempt is made to avoid courses which might encroach on offerings of local campuses in Wisconsin. This policy has helped ETN to build good working relations with state and private campuses. A typical student travels 3-10 miles to reach the ETN classroom. He or she is likely to be 31-45 years old and will, over time, take additional courses through ETN.

ETN has a faculty of approximately 1000 instructors. Some share a joint appointment between the Extension branch of the university and another department; others are full-time members of a department who teach an extra course at ETN (for which they receive an "overload" payment); and still others are from outside the university (they are paid an hourly rate). The telephone network also makes use of distant experts who speak to the students and answer questions over the telephone from Texas or New York or some

other location. An important motivation for teachers to participate is professional advancement; they demonstrate an additional job skill through ETN.

In addition, a number of uses for the system are not course related, e.g., teleconferences among working professionals.

4.3 Managing ETN/SEEN

The management team for ETN/SEEN consists of 22 people. Dr. Lorne Parker is director of the network. In addition to the paid staff, there are non-salaried program administrators at each site (often, these are emloyees of a county agency or the institution where the ETN room is located).

Use of the system is very high: typically, 15 hours per day. There is a minimum of 60 days' lead time between the conception of an idea for a course and the first day of class. Program planning is broken into seven stages: content selection and development; network scheduling; operational design; program announcement; promotion; registration; and production. Extensive promotion is conducted through direct mail brochures and occasional newspaper ads or public service TV spots.

Revenue for the network comes primarily from student fees (over 50% of operating revenues) and secondarily, from the state (approximately 30% of operating revenues). A small amount of development funding has come from federal sources. Student fees vary in relation to the ability of the student group to pay (e.g., a course for lawyers will charge more than an amateur photography course). In addition, some user groups (e.g., hospitals) pay an annual fee which covers a series of courses for staff at their institution or agency.

Courses and faculty are evaluated regularly through questionnaires to students. Survey results are used by ETN management and individual course instructors to determine

program strengths and weaknesses, make decisions about future programming, and build profiles of ETN and SEEN students.

Training tapes and brochures emphasize an informal style of presentation, short teaching segments (10-15 minutes), and encouraging questions and discussion from students, not simply waiting for them. They also suggest at least one face-to-face meeting between students and the instructor, where this is possible.

Equipment throughout the ETN/SEEN network is standardized. The Darome Convener, mentioned earlier, is at all sites. It is a modular unit: additional microphones and/or speakers can be added if they are needed. Dr. Parker reports that it is a sturdy piece of equipment which holds up well even if handled roughly. Repairs are centralized. If a unit fails, the local program administrator calls Madison. A new unit is immediately shipped out (a stock is maintained for this purpose) and the old unit is sent in for repairs. The standardization of equipment helps not only in arranging a repair procedure but also in detecting the cause of bad audio signals when they occur: the engineer in Madison can more easily determine if the problem lies in a transmission line or the equipment at a site.

4.4 Problems

Most of the current problems facing ETN/SEEN are the problems facing most large organizations. With 15 hours of programming a day, going to 200 sites, management must work continually to attract good teachers, train them to use the system effectively, and ensure that course offerings are in tune with what students need and want. Also, with 1000 faculty members and more than 33,000 students, the work load is enormous for the limited ETN/SEEN staff.

In certain content areas such as agriculture, the rate of growth in knowledge about new techniques is very high. It is important that ETN's courses integrate the most recent

findings. The burden to provide the latest techniques is greater for ETN than most colleges, since its student body consists of many working professionals who are taking courses specifically to update their skills.

When SEEN, the visual part of the system, was inaugurated in 1969, the state-of-the-art equipment available to transmit a graphic line drawing over telephone lines was poor. The response was to modify an existing piece of equipment (the Electrowriter) to make it serve needs better. Still not satisfied, the system is designing a new unit with far greater capabilities (e.g., color and alphanumeric displays).

4.5 Where Are They Going?

Recently, Dr. Parker and his group have begun to provide additional telecommunication services. One is a dial-access service of prerecorded capsulized information. For example, in "Dial a Garden" a user calls a telephone number and hears a prerecorded message about a particular gardening problem. The user discovers how to access the specific tape he or she wants (i.e., to learn about roses vs. asparagus) from a directory.

Another service is a dial-in bridge in which the user (who can be located in any state and any room which has an ordinary telephone) gains access to a course or teleconference by calling a number. In this way, the user is making the connection into the system from his home or office.

4.6 Replication

The Educational Telephone Network is one of the few applications of interactive telecommunications which have been replicated, in large part, by others. Systems in North

Dakota, Illinois, Kansas, and Texas have modeled themselves on ETN/SEEN.[4]

4.7 Lessons to be Learned

There are several important lessons which can be learned from the experiences at the University of Wisconsin-Extension. First, it is our impression that this highly successful system experienced just as many start-up problems as systems which failed. Success, in this case at least, is due not to the absence of problems but to an ability to deal with them. Second, the problems of managing an interactive telecommunication system may change with age, but they do not go away. ETN/SEEN requires continuing good management as it faces the problems of large scale operation and the implementation of new services. A feature of its current management structure informs about how to handle continuing services while implementing new ones. That is, a distinction is maintained between short term and long term planning, with staff assigned primarily to one area or the other. The short term planning group deals with program development, scheduling, etc. The long term planning group is released from certain day-to-day issues in order to plan the introduction of new services.

ETN/SEEN has dealt effectively with training large numbers of users through the use of booklets and tapes supplemented by direct in-person advice. (The reader who wishes to obtain good training materials for interactive audio systems should write for a list of ETN publications: Instructional Communications Systems, University of

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[4]For further information on these and other systems, see Electronic Education: Using Teleconferencing in Post-secondary Organizations, Robert Johansen, Maureen McNulty and Barbara McNeal, Institute for the Future, R-42, Menlo Park, Calif., 1978.

Wisconsin-Extension 975 Observatory Drive, Madison, Wisconsin 53706.)

ETN has developed excellent support services for faculty members, e.g., promotion and tape duplication. At the same time, it requires individual faculty members, or their departments, to handle the distribution of print or slide materials to sites where students are taking courses (most of these materials are mailed to students, in advance of class meetings). This task in itself might require a staff as large as ETN's current staff.

The standardization of equipment among sites has helped to create good technical quality and a manageable repair service.

Perhaps most important to the success of ETN/SEEN is the quality and scope of the management team. All the bases of operation (engineering, planning, training, etc.) are covered within the team, and meticulous attention is paid to the day-to-day running of the system. It is also noteworthy that, as a group, members exhibit a great deal of pride about their system and enthusiasm for their work. Lorne Parker, in particular, is a "product champion" for the system. These motivating values rub off in the operation of the system.

Finally, it is clear that ETN/SEEN provides a range of services to people who want them and who could not easily obtain them in other ways.

CHAPTER FIVE

Peoria Interactive Cable Television Project

The Peoria Interactive Cable Television project was designed to provide homebound instruction to handicapped students via two-way cable television (i.e., audio and video in both directions). It was conceived and implemented by the Cable Television Information Center in collaboration with the Illinois Division of Vocational Rehabilitation and General Electric Cablevision of Peoria. The Rehabilitation Services Agency of the U.S. Department of Health, Education, and Welfare provided major funding for the project.

5.1 Background

The Peoria project was submitted, originally, as a proposal to the National Science Foundation. The National Science Foundation had issued a request for proposals in the area of interactive cable television. The Peoria project received a planning grant from the NSF, along with seven other projects, but it was not one of the three finally selected to be set up as a field trial.

Subsequently, the Cable Television Information Center scaled down the proposed project (the NSF field projects received funding in excess of one million dollars each) to a budget of approximately $150,000 spread over three years. They sought and received funding from the U.S. Department of Health, Education and Welfare, Rehabilitation Services Agency.

Planning began in 1975. Technical design, purchase, and installation of equipment took place in 1976. The system officially opened for business in January 1977, and the project was cancelled a few months later.

5.2 How the System Was Designed to Work

The system was designed to let an instructor located in the studio "headend" of the cable company interact with students who were located in their homes. The students could see and hear the instructor on their television sets. The instructor could see any one of the students (there were to be 5-10 students per class) by pressing a button on the console at the headend. The student's video signal could be displayed for the instructor only, or, at the instructor's option, it could be sent "downstream" for all of the students to see. The audio portion of the interaction did not require any switching. A student could speak at any time and be heard by everyone (i.e., by both the instructor and all the other students in their homes).

5.3 Technical Design and Implementation

The Peoria cable system which was in place at the start of the project had the capacity for two-way transmission. However, it had not been used for transmission from a subscriber's home and modifications were required to accomplish this. A significant amount of work during the project involved making these modifications.

The equipment in each student's home included an inexpensive black-and-white camera (cost: approximately $200.00), a microphone (cost: approximately $20.00), and a terminal. The terminal was at the heart of the return signal and it was a source of enormous trouble. The three functions of the terminal were: (1) to transmit the student's video signal "upstream" to the headend studio when it was switched on; (2) to activate the video switching when it received a triggering signal from the instructor's control panel, and;

(3) to transmit the student's audio upstream continuously. This crucial piece of equipment was not available off-the-shelf when the project started. Bids were requested from manufacturers to build a custom piece of equipment, based on the project team's specifications. The larger cable equipment manufacturers declined to bid, stating that it would be unprofitable to manufacture only ten terminals (the number requested by the project team). Of the companies who did submit bids, estimates varied a great deal. The project was required by state law to accept the lowest bid. This bid (just under $10,000.00 for the ten terminals plus some additional equipment) was submitted by a small company in Oklahoma City.

The terminals never worked properly. Difficulties started before the terminals were shipped. The cable company had not completed modifications in the system to allow a return signal from students' homes. Thus, the terminals could not be tested in a field situation when they arrived. Instead, a test in a laboratory situation was substituted. Although the equipment did not work properly in the test, it was accepted and paid for. The company was asked, however, to take the terminals back to Oklahoma City and adjust them. Distance between Peoria and Oklahoma City appears to have hampered communication between the project team and the manufacturer. In addition, the manufacturer was either unable or unwilling to make the terminals work properly. Months passed and the project team finally demanded that the terminals be shipped to Peoria, no matter what their operability. At this point, the project team attempted to fix the terminals with the help of a local engineer. He could not make them work properly, and the implementation effort was further delayed.

Next, the project team decided to jerry-rig the equipment and get underway in whatever manner was possible.

Remote switching of student cameras was abandoned. Instead, the student or someone in the room with the student was required to turn the camera-modulator on manually whenever they wanted to transmit a picture upstream. This worked surprisingly well, though the quality of the picture was adequate at best and lighting was a problem in some students' homes. Use of the terminal for audio transmission was abandoned completely. Indeed, they did not use the cable for audio transmission, but incorporated the telephone company's Homebound Student Service into their system. That is, the video portion of the interaction was sent over the cable, while the audio was carried over phone lines. Each student had a push-to-talk microphone and a speaker. The teacher had a speaker for each student participating in the class, and one microphone. The speakers were grouped together with the microphone on the teacher's desk, so the output from any one would be picked up on all the other lines. In this way, everyone could hear everyone else. This hybrid arrangement worked adequately. Moreover, it was inexpensive. Total cost for the speakers and push-to-talk microphones was $162.00 for installation, plus $148.50 per month. This included a microphone-speaker unit in each student's home and nine speakers plus one microphone on the teacher's desk. With this arrangement, they began classes in January, 1977.

5.4 Administration of the Project

At the same time that the project was experiencing technical problems, there were administrative difficulties. In the original proposal to the Illinois Division of Vocational Rehabilitation, it was stated that there would be a full-time, on-site manager. In subsequent negotiations, the Cable Television Information Center moved away from this position. However, the Illinois Division of Vocational Rehabilitation continued to expect and want a full-time, on-site manager. In practice, there was no on-site manager

from the Cable Television Information Center available on a full-time basis. Instead, a local administrator supervised the system on a day-to-day basis.

In addition, leadership at the Illinois Division of Vocational Rehabilitation changed during the course of the project. The new group may have been less enthusiastic about the project in general. Whatever their motivation, they cited poor technical quality, high costs per student to deliver services, and inadequate management as their reasons for cancelling the project three months after it began operating. In addition, the management team was hampered in the selection of students to participate in the project by very stringent criteria which eliminated many appropriate candidates and increased the cost of selection. The criteria were a byproduct of the funding source (HEW) rather than the aims of the project.

Interestingly, the handicapped students (a total of eight took part in the project) were very enthusiastic about the service. They found the technical problems tolerable and the socialization provided through the two-way cable system extremely valuable. In addition, one of the courses offered, "Daily Living Skills," was rated highly. The other course, "Insurance Claims Adjustment," was rated poorly because it used a one-way lecture format and because it prepared students to do a job which was not available to them after they finished the course.

The cable company in Peoria made some very reasonable suggestions about how to make the system work. These involved the purchase of existing off-the-shelf equipment which the company believed could do the job. However, the Illinois Division of Vocational Rehabilitation had lost confidence by this point and would not fund the purchase of additional equipment.

5.5 Lessons to be Learned

A few lessons emerged from the Peoria project. In relying on a small manufacturer who is far away to build custom equipment, there can be difficulties in correcting problems which arise. Distance makes it more difficult to knock on a manufacturer's door or otherwise put pressure on him to make repairs. Small size can mean that a manufacturer is less able to absorb a loss if he has bid too low on the job.

The Peoria project was locked into their position by a state law which required the acceptance of the lowest bid. Their experience suggests that "low bid" should not be the only consideration in selecting a manufacturer. Price should be weighed against quality and reliability.

It is difficult to generalize and argue that custom equipment should be avoided. There may be no other choice in some situations. However, when a custom piece of equipment plays such a crucial role as here, adequate time and funds must be allocated to pre-test and debug it. Here, again, the Peoria project may have been locked into a position of inadequate funding. They scaled down their original design when they did not receive funding from the National Science Foundation. In doing so, they lost the backup funding which might have rescued the project from the equipment problems they encountered.

The absence of a full-time, on-site manager from the Cable Television Information Center may or may not have been a significant element in the way they dealt with technical problems. However, it clearly weakened their political relationship with the Illinois Division of Vocational Rehabilitation (IDVR). This political weakness, combined with a change in leadership at IDVR during the project (a factor outside the control of the project team), meant that

there would be little strength in the project team's effort to win support from IDVR in the last phase of the project.

Two positive lessons emerged from the project. First, the hybrid arrangement of telephone lines for audio transmission and cable for video transmission worked surprisingly well. It suggests that non-traditional mixtures of equipment and transmission systems are worth exploring further. Second, the enthusiasm of the handicapped users for the Peoria project provides additional evidence that a service which is wanted and needed by users will be accepted even when technical quality is less than ideal.

CHAPTER SIX

Research Context and Objectives

Field trials and demonstration projects must make sense in two distinct contexts. The research context generally features a concept or hypothesis which is under investigation. There are, typically, associated linkages with a funding agency and with a more inclusive program of research. The service context includes the technical system, user organization(s), project management team, and other elements in the operation of the telecommunication system.

The focus of our study was upon the practical problems which arise in setting up field trials and demonstration projects. Hence, we placed a strong emphasis upon the service context. Nevertheless, the research context has many implementation problems connected with it. There may also be conflict between objectives derived from the two contexts.

6.1 The Research Context

Field trials are instruments of research while demonstration projects are generally not.[5] So when a field trial is proposed, it is necessary to determine whether it is the most appropriate instrument. It may be that some less

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[5] In practice, the distinction is blurred by some government funding agencies which find it administratively more convenient to use one term even though it is the wrong one.

costly activities should be undertaken first. A field trial or, especially, a demonstration project may fittingly culminate a research program. It should hardly initiate it or be treated as a self-contained activity.

6.1.1 The ongoing research process. A field trial may be one step in an ongoing program of research. Alternatively, the project team may treat it as an isolated activity. The distinction, loosely speaking, is between seeing the trial as part of a research process and seeing the research process as part of the trial.

A classic example of the former (a trial as part of a research process) is the telemedicine research of Conrath and Dunn (1977) in Canada. They designed a four-stage program: observation, laboratory experiments, field trial, followed by the implementation of a regular service. There are several other examples in the projects within our sample. The Institute for the Future developed PLANET and FORUM, its predecessor, as research tools and used them in a series of trials, improving them as they went, in order to develop their understanding of computer-mediated communication. From AT&T's point of view, the Phoenix Picturephone® trial may be seen as one step in their ongoing evaluation and development of switched visual services. For NASA, STARPAHC is a step in the process of finding ways of transferring space technology into other fields. And finally, the Union Trust teleconferencing system was originally conceived as a field trial within the New Rural Society project.

There are also examples of projects which were treated as self-contained activities. It is necessary to ask how well they relate to relevant theory (and, if intended as field trials, what contribution they make to it). It seems likely to us that lack of theory explains both the occurence and the non-solution of problems which arose during the implementation of some of these projects. Models of how the

technology would be of practical value to users were less well developed and less realistic; possible problems of individual and organizational adaption were unanticipated. Naturally, lack of theory is more likely to be a problem for teams coming fresh into the field to conduct a project.

6.1.2 The appropriateness of field trials. Questions to which some field trials have been addressed might more appropriately have been addressed by other means, initially at least. If an alternative approach would have yielded only partial answers, one might still have been able to enter a later field trial with a more suitable technological design and on the basis of more information regarding users' reactions, costs, and so on. Further, more modest research might weed out certain concepts unsuitable for a field trial.

To take just one example: uncertainties concerning the efficacy of a novel system for teaching over a distance could be investigated in a controlled experiment after installing the system between two rooms on a back-to-back basis. This would not, however, be nearly as useful in determining whether remotely located students would enroll in classes relying on use of the new system. It is necessary to be specific about the uncertainties one is seeking to reduce and to arrange them in a sensible order.

6.2 Objectives

Some telecommunications systems are set up with the single objective of providing a valuable service to their users. Such systems have been installed by, for example, NASA (its audio-conferencing system), the Philadelphia police, Rural Health Associates, the University of Wisconsin-Extension, and First National City Bank.

Other systems are set up for demonstration and/or research purposes. While they, too, provide service to their users, there are external clients as well--i.e., those whose work may be informed by the demonstration or the research

findings. All the NSF funded projects are of this kind; so too are many of the telemedicine projects.

In our earlier working paper, Elton and Carey (1978), we set up a four-way classification scheme based upon the relative importance of a project's internal (user-related) and external (generalization-related) objectives. This provoked some disagreement. While readers generally accepted it as a helpful conceptual framework, several felt strongly that their own project had been misclassified. We sometimes disagreed.

The subject is sensitive and indicates, at least from our perspective, that stated objectives in proposals and reports were not always consistent with the objectives of on-site managers and project directors.

6.2.1 Sources of confusion. Several factors confuse any analysis of objectives. The relative importance of an individual's objectives can change with time. There are multiple actors. Different actors enter and leave the scene. Sometimes there are different elements within an overall project team, each in pursuit of a different primary objective (for example, "implementers" and researchers).

6.2.2 Relationships between objectives. Two types of conflict between objectives have been noticed. One occurs when service-provision and research (or demonstration) objectives conflict. The most obvious example is when, to preserve the integrity of a control group, a research design imposes constraints on the promotion of a new service or the population to be served by it. Another example is the burden of data gathering procedures on the population served and its servers. But there are suggestions of dangers which are more insidious, because harder to detect: the design of services or selection of sites which lend themselves to a classical experimental design, even though they may be substantially less favorable to the concept under study; and the diversion

of attention to research procedures to the extent that the trial service attracts far too few users.

The other type of conflict is between the objectives of a project team and those of a funding agency. However, it is our impression that during a project these have caused trouble only after it was clearly failing according to anybody's standards.

It is clear that, unless subjects are offered artificial inducements to use a new service[6], the service provision objective must be taken seriously. This may place a project team under considerable moral pressure to introduce the service so that it will continue at the expiration of a research or demonstration grant. However, this is unlikely to be within the funding agency's terms of reference. Nevertheless, it may be able to use its influence helpfully to this end and we can see only good coming of very early discussion of the subject between the project team and its sponsor.

6.2.3 Some approaches to conflicts arising from research designs. When an experimental or quasi-experimental design is used, it may also be necessary that the treatment--i.e., the service--should be held constant. This may mean rejecting or delaying improvements in the service. And this, of course, can provoke conflict.

Lucas has suggested a way to solve this problem, which is illustrated by his work in Spartanburg (Lucas et al., 1979). One of the applications investigated involved teaching via a two-way cable television system. This project was divided into phases. At the end of each phase, measures

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[6]Conrath and Dunn offered payments to subjects in their trial though they were rarely accepted (Conrath and Dunn, 1977).

were fed back to the teachers on the basis of which they were free to--and actually did--change their ways of using the medium. This meant that any significant difference in outcomes in any phase could be attributed to an identifiable treatment. The interested reader is referred to Lucas and Quick (1978).

In the above case a project was divided into steps. Structural changes were permitted between, but not during, steps. The approach may be compared with a research program, such as that described by Conrath et al. (1977), which is divided into discrete phases, of which a field trial is one. Both approaches acknowledge, in a practical way but without sacrificing research rigor, that at the outset uncertainty may be too great to allow one to choose and stick to a particular treatment.

Although we have come across no example of its application, there is another approach to avoiding these conflicts. (And it may also be an appropriate approach when a rigorous research design is infeasible.) It would require redefinition of the research role so that its most important function would become the provision of assistance to those setting up and managing the trial service (and to the others to whom they report). Thus, research would serve the ends of the trial (as well as the trial serve the ends of research).

That this could materially reduce conflict is plausible enough, but that it could also provide credible evaluation of the trial system may seem more far fetched. The latter possibility is, however, well illustrated by the process of operations research as it was originally developed about four decades ago, rather than as it is generally conducted now (see, for example, Waddington, 1970).

The design of a recent Canadian program of educational experiments using the CTS satellite did leave open this possibility, even though it did not require it. Evaluation

was conducted using a two-tier approach. There was a local research activity associated with each project but an overall assessment was conducted by a distinct central research team that worked with counterparts at the local level (see Daniel et al., 1978).

CHAPTER SEVEN

Needs Assessment and Project Preliminary Planning

This chapter considers the concept of need; the process of conducting a needs assessment; and some of the components which make up the planning for a project.

7.1 Needs

It has often been observed that a particular service failed because it did not meet a "real need." (Generally, this is to be understood as a stronger statement: there was no real need it could have met.) Such statements may make nice epitaphs, but it is not particularly easy to turn them into practical and useful advice for the living. In part, this seems to result from confused thinking about the concept of need.

Needs of the kind with which we are concerned are relative, rather than absolute. They can be created by providing people with something which subsequently they are not prepared to do without. They can be created by removing alternate means to desired ends. In this sense it is "perceived needs" or "wants" which matter; "real need" has no useful meaning.

The term "need" can also be used to express a logical necessity. (To speak with someone in another city without leaving my home, I need to use the telephone.) There are logical needs as well as perceived needs. It may be that a telecommunications service with certain characteristics would be logically necessary to some new activity--maybe to

participation in a discussion by a number of people who are unable to leave their separate locations. The new activity, however, may not be, or become, a perceived need. Clearly, one must consider need at the level of the whole innovation.

Notice that need here is determined by the difference between some notion of how things should be and a view of how they are. The former standard may be established by policy, by legal requirements, by statistical comparisons between communities or organizations, or by other means. Often it will be decidedly arbitrary. Moreover, one may really be focusing on opportunities seemingly presented by a new use of technology, rather than needs.

7.1.1 Empirical Observations. Some empirical observations are provoked by the experience of the projects in our sample. Needs may range from strong to weak. The strength of a need can have a major impact on a project, particularly when a telecommunications application must deal with a number of problems. In one situation, users who experienced few technical problems reported that technical problems were a major deterrent to their using the equipment. However, users in another situation, one which had many technical problems, reported that technical problems were not a deterrent to use. These seemingly contradictory reports are explained by the fact that the second group was widely separated physically and had no adequate alternative to teleconferencing. The strength of their need affected their perception of the equipment and their willingness to live with technical problems (Casey-Stahmer, 1973).

Need is often treated as something which is static and one dimensional. However, needs change over time and some needs may be surrogates for others, e.g., the desire to make money or advance one's career or to protect the interests of a private group. It is useful to understand when a seeming communication need is a surrogate for something else. This

knowledge may suggest an alternative approach to a particular problem.

One should not assume that an "obvious need" of an organization is something wanted by the members of that organization. It is commonly assumed that "better communication" is both a need and a want for an organization. Often, this proves not to be the case. A telecommunication application may encourage more meetings than are necessary or bring people into an encounter under the wrong circumstances. Even if there is an "objective" need for such communication, users may not want it. Put simply, "What's in it for me?" They may not want to do their jobs better, or may simply oppose any change in their current pattern of work. Similarly, a planner may assume that people will value ease of communication, saving time and saving money. This is not always true. In some instances, a symbolic value of "importance" is placed on a meeting where one or both parties travel. This value can supersede any savings of time or money.

Commonly, telecommunication equipment is installed to meet one need, but is used to meet another. Thus, in the Bethany/Garfield Picturephone® trial, the Picturephone® was often used as a "hotline." It made it easier to get through. However, this usage had little to do with the intentions of those conducting the trial. Users in the hospital were employing Picturephone® to convey messages that would ordinarily be sent on a telephone (Noll and Woods, 1979).

Nor can one take perceived needs at face value. Sometimes, potential users of a teleconferencing service have expressed a need (desire) for full-motion video. Yet with experience, they have quickly come to be satisfied with an audio system.

The degree of need will vary from one possible field site to another for a particular application. Practical

constraints may lead one toward sites where the need is relatively weaker. The resulting danger is obvious.

In sum, analysis of assumptions about need is a decidedly necessary, but demanding, activity. When considering need, it is a useful mental discipline to complete the phrase, "need in order to. . . ."

7.1.2 The substitution paradigm. Much current thinking about telecommunications views it as meeting a need to substitute for in-person communication which ordinarily requires travel. There is a good reason to challenge this thinking. Two objections in particular are reinforced by the experience of the projects we considered. First, telecommunication has often proved valuable in providing communication on occasions, or between people when the alternative would have been no communication, rather than travel to an in-person meeting. Second, the thinking neglects significant secondary adjustments. For example, within the context of a pre-existing organization, the time and money saved by direct substitution may be reinvested in other activities, e.g., in some additional travel. Net savings in travel expenditures may be illusory, even though other benefits accrue.

What telecommunication offers is a relaxation of constraints. Thinking based only upon the substitution paradigm is likely to miss the potential benefits of uses other than substitution and to overestimate the degree of direct substitution which will occur (unless other constraints are to be imposed--e.g., administrative restrictions on travel).

Telecommunication systems may relax constraints even when they are not used. Their availability may be sufficient to achieve some desired effects. For example, a telecommunications service in health care can allow a local service provider to call upon someone at a distance for

advice. The fact that the local service provider can communicate if she or he wants to do so may have desirable effects, even if this choice is hardly ever made. (For example, the local person may feel more confidence in undertaking an activity which would otherwise be seen as too risky.) The desire to achieve these effects can provide the rationale for implementing the telecommunication service.

7.2 Preliminary Planning Studies

In this section we consider three types of studies which may be undertaken as preliminaries to a field project: needs assessment, design, and pilot studies. They are all parts of an overall planning process which can lead to a field project. The extent to which they precede or are included in the entity which is proposed for funding varies considerably.

7.2.1 Needs assessment. Needs assessments are undertaken to determine the extents to which different services will be useful to a particular population of users. In embarking upon them one has, at the outset, delimited a range of possible ways of meeting those needs--in this field, ways that involve telecommunications. Possible solutions falling outside the boundaries of interest generally will not be pursued. One is in the position of solutions (admittedly a range of solutions) looking for problems. (Moreover, one is probably under strong pressure to find something.) This fundamental weakness of needs assessment, coupled with our earlier remarks about needs, form the basis for our reservations about such studies.

One may prefer a process of diagnosis and problem-solving that is more closely related to, and responsive to, the client systems served in a resulting project. It must, however, be admitted that needs assessment is a necessary evil, given the organizational structure from which project funds flow. Certainly, a needs assessment is substantially

better than nothing in filtering out schemes that would not be worth pursuing and in providing information useful in the planning of those which would.

Useful models for conducting a needs assessment are available from the literature (Spartanburg; Phoenix Criminal Justice System[7]). The process addresses a number of questions which may be answered before it is decided to provide a trial or demonstration service in a particular setting. Typically, answers should be provided to questions such as the following:

1. In what ways is the functioning of a particular organization, set of organizations, or community below "standard"? (Whatever the standard may be.) How, therefore, may new telecommunication services, or other new services relying upon telecommunication, bring functioning up to standard? For the purposes of such exercises, this determines the needs.
2. Is a need recognized? By whom? Do prospective users want a service to meet the need?
3. Is telecommunications a way, the best way, the most efficient way, to meet the need?
4. Is the technology under consideration adequate to provide the needed service? Is it excessive (overkill)?
5. Are the anticipated costs of the system in line with what could be recovered from interested parties following a period of grant support?
6. What changes are necessary, over and above the telecommunication service, to meet the need, e.g., reorganization of work schedules by users?

7.2.2 Outline design. The overall design will have a number of components which must fit well together:

1. Technological design (this involves selection and location of equipment, etc.).
2. Design of the organization to support the technology (this may have to deal with maintenance, reservations, etc.).

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[7]In both projects, it may be noted, some results of the subsequent trials were considerably at variance with conclusions based on the respective needs assessments.

3. Design or re-design of the organization(s) which will be using the technology (sometimes).
4. Research design (sometimes).

As a project unfolds, changes in certain components are likely to become necessary. This necessity may be substantially reduced by conducting a pilot project beforehand. Nevertheless, some change may still be required. This places a premium upon flexibility in the design. An important way of preserving flexibility is to leave decisions open until pilot studies have taken place.

7.2.3 Pilot studies. Pilot studies allow one to try out alternative configurations of equipment under actual operating conditions, test operating procedures, and identify possible problems in advance. They also provide opportunities for building project teams. Not surprisingly, pilot studies have proved valuable across a wide range of projects, even when off-the-shelf equipment has been used.

We have come across three types of approach: (1) pilot operation at the intended site(s) or a subset of them (e.g., Boston Nursing Home); (2) simulation of the intended technological system at other sites (e.g., STAHRPAHC); and (3) trial in a specially developed laboratory environment (e.g., in Mitre Corporation's Telehealth Care Program).

7.3 Resources Planning

One of the main purposes of planning is to ensure that necessary resources will be available at the right time. If problems such as those described in other chapters are not anticipated, the resources to overcome them may not be available. In order to reduce the likelihood of problems once the project is underway, the following questions should be answered at the planning stage:

7.3.1 Some questions to be posed at the planning stage.

1. Where will those with the technical skills for installing the system come from? If they come from a distance, will they be available to make modifications?

2. Are costs for modifying the system during the implementation phase in the budget? Most projects report that there were moderate to significant changes during this period.

3. Are equipment repairs anticipated in the budget? What kinds of repair service are available?

4. Have all side activities been anticipated? (For example, a microwave system may require an environmental impact study.)

5. Are political and organizational problems anticipated and planned for? Solving these problems is often a more time consuming job than expected. Many projects have reported that these issues were a major stumbling block.

6. What mechanisms will be used to monitor on-site implementation activity? Will communication between project management and lower level staff be adequate? This communication is especially critical when management is located at a distance.

7. What is the quality of the implementation staff? Are they sufficiently skilled to deal with both anticipated and unanticipated technical and administrative problems? Will the staff, and consultants, be there when needed?

7.3.2 Time and money. Obviously, it is necessary that there be enough time and money for completion of the project. Most of the teleconferencing projects, for which we have the information, reckoned that they had enough time and money for implementation. However, investigators on more than half the telemedicine and two-way cable projects felt that they did not have sufficient time. Shortage of time, whether caused by initial miscalculation or constraints imposed by funding sources, has turned out to be a substantial problem in a number of projects. Sometimes it has set off a chain reaction, as when squeezing out a pilot stage.

It is not surprising that it is the types of projects explicitly involving organizational innovation that have experienced these problems. It is not as easy to interpret the fact that almost all these projects felt that even though short of time they were adequately funded; generally a longer duration requires more money. Our interpretation is that it

was the rate of expenditure, once initial investment had been made, that was considered adequate.

7.3.3 The proposal as a planning document. To plan well one must, among other things, identify what may go wrong, then take steps to reduce the probabilities and consequences of these occurences. Plans included in proposals must be taken with a grain of salt. Proposals are written to "sell" projects. The prevailing view on both sides of the funding fence is that known problems often have to be suppressed.

This means that predictable stumbling blocks cannot be dealt with in the budget or in the allocation of time and personnel unless money and time are disguised in the proposal under another heading. Especially for externally funded projects, the gamesmanship of proposal writing makes a negative contribution to dealing with the real problems implementers will face in the field. However, the problem should not be overstated. Experienced program managers (in funding agencies) and principal investigators, it has been observed to us, know the rules of the game. The former tolerate or require some provision for the "unexpected." The latter will develop real operational plans, even if they are selective about when and with whom they will share them.

7.3.4 The language of the plan. Plans typically have to be shared with managers, users, and various agencies. We have received a number of adverse comments on the impersonal, technical, and abstruse jargon in which the corresponding documents are written. Presumably, these are often the same documents as are presented to funding agencies in proposals. There is a desire by funding agencies, as well as personnel in the field, for more clarity about how projects are intended to proceed.

Notice that a planning document can set values for everyone involved and that the words used may be seen as

reflecting the values underlying a project, including the value placed upon communication.

7.3.5 Techniques. In discussing planning, one project leader (Philadelphia Police) emphasized the value of network analysis (of the PERT variety). Other techniques of planning and control have been found useful in more complex projects (e.g., STARPAHC). In one project (Phoenix) a technique for site selection was specially developed (Stockbridge, 1978). Nonetheless, most projects seemed to manage well enough without special techniques.

7.4 Participation in the Planning Process.

Planning is not just a matter of producing plans. It is a process which provides opportunities for uncovering problems and opportunities, for learning, and for generating commitment and mutual trust. Hence, the emphasis which many organization theorists place on participatory planning.

There is no distinct dichotomy between participatory and non-participatory planning. The extent to which interested parties were involved in the planning of the projects in our sample ranged from very low to very high. Nor does high involvement necessarily imply genuine participation; it may mean being manipulated or subjected to endless questionnaires.

Our information provides no direct evidence to support the proposition that participatory planning makes the eventual success of a project more likely. There are some examples of decidedly non-participatory planning being followed by success and of highly participatory planning being followed by failure.

Two observations on the subject can be offered. First, many of the things that subsequently go wrong are of kinds which participatory planning should help make less likely: for example, unexpected user-related problems and lack of trust. This may be seen as indirect evidence in support of

participatory planning. But notice that such planning is not a technique, though it can be enhanced by technique; it reflects a set of values and assumptions which must be maintained throughout a project.

Second, when the innovation in question is limited to the introduction of a new telecommunictions service, which is unlikely to have major implications for the way users conduct their affairs, then participatory planning is probably both less valuable and less feasible. Audio-conferencing services provide an obvious example.

We see no reason to doubt that involvement of users is worthwhile. However, it is also important not to overstate the case. Users and managers may not always be able to make the necessary time available. Also, users do not always know what is best in a situation, e.g., which equipment is most appropriate.

The pitfalls of too much or too little user involvement can be stated simply: a project which ignores a user group in the process of implementation risks failure; one which follows blindly all of the suggestions and wishes of a user group also risks failure.

7.5 Operational Plan

In addition to the preliminary planning studies outlined in this chapter, there is need for a much more specific operational plan containing such elements as installation of equipment, management of the project, and training of users. We turn to these topics in the next two chapters.

CHAPTER EIGHT

Installing the System

This chapter deals with: deciding where to put equipment; the importance of a comfortable setting; choosing equipment; the reliability of existing hardware; installation and repair services; the special problems of installing good audio; and some unanticipated problems which seem to delay most projects.

8.1 Location of Equipment

The physical proximity of the telecommunication equipment to where a user lives or works is very important. Some potential users consider two floors up in the same building where they work as "too far" to go for a teleconference. This is one reason why public studio conferencing systems, where users must travel a few blocks or a few miles to use a teleconferencing room, have not proved as successful as in-house systems. The assumption that a user would be willing to travel a short distance in order to save traveling a great distance may seem rational but it has not proven correct in many instances. Potential users, especially in a business context, tend to think of a telecommunication system in the way they think of an ordinary telephone or a Xerox machine: it should be close by, in their immediate work space. Less sophisticated and expensive equipment located in a user's immediate vicinity may be better used than more expensive equipment which is less conveniently located. This issue is highlighted in the case

of the user who said that if he had to travel across town with all the traffic and related problems, in order to use a teleconference room, he might as well go on to Chicago (Hough, 1977).

Another issue which bears on the location of equipment is territoriality. Whose "turf" is the equipment located on? Employees of a government agency or a corporation which strongly values internal control over equipment and communiction may be unwilling to go to any space which is not "theirs." Even within a building, territoriality can be an issue. Equipment located outside the boundary of an office or department may not be used. At NASA, it was found necessary to locate audio conferencing rooms within the space of each project, even where projects shared the same building. For example, people working on the Space Shuttle Project required their own room, as did the Apollo Project employees (Fordyce, 1977).

There is some evidence that the number of transportation modes a person must use in order to reach the equipment (and the perceived difficulty of getting there) can create a barrier (Moss, 1978). In the latter instance, it is suggested that user attitudes are affected not simply by the physical distance between equipment and a user, or by whose "turf" it is on, but also by how many transportation barriers (e.g., ride an elevator, go out of a building, take a bus, etc.) stand between a user and equipment. Presumably, a telecommunication room might be relatively close to a user, but if he or she has to take two elevators, climb a stairway, and pass into a separate wing of the building, it may discourage use. It can be helpful to consider the normal traffic patterns of users. Where does a user normally go during the course of a day? Equipment can be located at intersection points where many users pass during a normal day. This strategy has particular importance when equipment

cannot be located physically close to users because they live or work in different places.

It is useful to determine the social definition of the room where telecommunication equipment will be located and whether the definition is compatible with the usage intended. For example, are nurses being asked to use an old storage room for teleconferences? This may be less of a problem if the room will be altered significantly for the telecommunication application. Also, some groups (e.g., students) are more malleable than others (e.g., a corporate board of directors). For example, Champness (1972) cites a person who used teleconference equipment while it was in his office, saying that he used it in "an executive capacity," but stopped using it when it was moved to an office right next door, a room defined as a "conference room." Similarly, the sharing of a space (e.g., when one room is used for telecommunication and xeroxing) has been problematic in some instances. Dedicated space is clearly better. Where it is not feasible to obtain dedicated space, it is important that the schedules of different types of users be compatible. Problems may also arise from proximity to undesirable spaces. For example, outside noise has created difficulties in applications which involved an audio component.

Selection of locations for equipment is often a matter of accepting what is available. It is unlikely that good space is ready and waiting to be used in most existing office buildings, hospitals, schools, and so on. For this reason, in particular, the location of equipment has been a frequent source of difficulty among applications to date.

8.2 Comfort

Seemingly minor aspects of a telecommunication situation can have a major impact on users' attitudes towards a system. Physical elements such as uncomfortable chairs, a light that glares in one's eyes, or noise from an adjoining

room, can affect perceptions about the system as a whole. In addition, the psychological "repercussions" of procedures for getting to speak, user training methods, and other behavior-related features of a telecommunication situation are critically important.

8.2.1 Physical comfort. Issues related to physical comfort are relatively easy to identify. If the lights are uncomfortable for the implementation team, chances are they will be uncomfortable for users; likewise, seating arrangements, outside noise, cramped space, etc. Other problems which may not be immediately obvious can be uncovered by bringing some potential users into the space in question and asking them if it is comfortable.

The difficulties which have arisen were generally not due to a lack of concern about physical comfort, but to the inability of the project team to do anything about them, e.g., color cameras required strong lights, or a cramped room was the only one available. Where the project team had some flexibility in arranging the room or situation, physical comfort has not been a significant problem.

8.2.2 Psychological comfort. At times, users have reported that they feel someone is "looking in" on their behavior while they are engaged in telecommunication activity. Curiously, this has been reported more commonly in relation to audio/video systems than audio-only or computer conferencing. The general phenomenon is often called the "Big Brother Syndrome." Few projects report that it is a serious or crippling problem. Where it does exist, users may be relieved if they understand how the system works. In some instances, project managers have installed a separate, private phone line in the room, or nearby, to permit private communication (Philadelphia Police Department). In still other projects, a scrambled signal is transmitted to ensure privacy (Veterans Administration ATS 6 Experiment), or a

sign is displayed telling users not to say anything which is under a security classification (U.S. Department of Energy).

Another cause of psychological discomfort is potential embarrassment. Certain projects have reported that some users fear making a fool of themselves by being unable to operate the telecommunication equipment correctly. A great number express a general concern with how they are "coming across." A related concern may arise in certain situations when a person merely suggests the use of the telecommunication system, e.g., when person A previously visited person B, and subsequently fears that the suggestions of a teleconference in lieu of a face-to-face visit might imply less interest in B or less value in the meeting. Problems related to potential embarrassment are reported commonly, but not as serious or crippling handicaps.

The "social definition" of a space where equipment is located, discussed above in section 8.1, also affects psychological comfort. A project manager should ask whether the telecommunication space is an open public area, a conference room or a private room; whether it is a place for formal or informal interaction; and whether the social definition of the space supports the content and style of communication which users want. At the Department of Energy, many users eat their lunch while teleconferencing. The social definition of the space permits this, with positive results.

In addition, the ways in which chairmen and chairwomen, instructors and operators treat users and the protocols or procedures for getting to speak, chairing a session, and organizing the information components, such as slides or print materials, can have a marked effect on general psychological comfort.

8.3 Choosing Equipment

In reviewing the broad sweep of interactive telecom-

munication applications in the U.S., there is little consistency in the choice of equipment or the design of rooms. (For a valuable, though dated, survey of teleconferencing system designs, see (Hough, 1977). For telemedicine, see (Bennett et al., 1978).

The following points are important to note in choosing equipment.

1. The matching of equipment characteristics to user needs and situational constraints requires considerable attention. Among the problems which have occurred are: a remote control zoom lens was too slow for a crisis situation in a hospital setting; equipment was not sufficiently protected against dust; the wrong microphones were selected for a situation where there was much background noise; the video monitors were too small and placed too far away for a user group which consisted of many people with poor eyesight. Knowledge about the user group and the situation where equipment will be placed must inform the criteria for selecting equipment.

2. While it is valuable (and often required by government agencies) to obtain more than one bid on equipment, it is foolhardy to choose equipment on the exclusive basis of the low bid. Low bid is one important criterion for selection, but only one of the criteria which should be employed.

3. Often, equipment must be modified or adapted for a particular situation (e.g., use of a nonstandard lens for a camera or enlargement of a keyboard for computer conferencing by handicapped people). It is important to identify what adaptation will be required and to choose a manufacturer and installer who are able to make these adaptations.

4. It is better to purchase off-the-shelf equipment (which is cheaper, more readily available, and tested in use) provided it meets the needs of the application. There are important exceptions, e.g., projects which rejected off-the-shelf equipment and designed their own, with positive results (the Educational Telephone Network at the University of Wisconsin-Extension, and the Philadelphia Police Department). Note, however, that these were long-term evolving projects, not field trials or demonstration projects.

5. Installation and repair of equipment are so important (see 8.4) that the quality and availability

of the associated services should be included in the criteria for selecting equipment.

It has been a common experience that some equipment had to be changed after a project was under way. This has happened because the original choice: was not appropriately specified for the needs of users; was too costly to operate; or did not perform as specified by the manufacturer. In addition, problems have been reported when discontinued models of equipment were purchased (replacement parts were not available).

The variations in need from one user group to another, or from one room or situation to another, may preclude the development of simple telecommuncation packages that work well for many users/situations. The development of successful equipment packages is likely to depend on the degree to which applications emerge in groups with similar equipment needs and whether manufacturers can develop modular packages where each component of the package has a number of interchangeable units which can be selected to match the needs of particular applications.

8.3.1 Equipment reliability. Generally, users expect a high degree of reliability from equipment. When they do not get it, their reactions will vary in relation to: their expectations (e.g., physicians are less tolerant of equipment breakdowns than para-professionals); degree of need; whether use is voluntary; and other positive aspects of the experience (e.g., whether they enjoy using the system).

In order to safeguard against unreliable equipment, it is useful to build redundancy into the technical system. In this way, one may switch to the alternative or backup equipment rather than lose communication entirely or continue with bad equipment until repairs can be made. Redundancy is generally more important in the audio equipment. In most situations where there is an audio and video component, some

interaction is possible by audio alone. When audio is lost, video alone is typically not sufficient to continue the interaction. The audio backup which is used most commonly is a telephone. A telephone link, which supplements a cable, satellite or microwave link, can be used under normal conditions as a back channel, i.e., a channel for conveying information which one does not want to be heard in the prime channel. Then, when audio problems are experienced in the prime channel, the telephone link can substitute as the prime channel for communication. In addition, a separate emergency phone number has been used in audio conferencing and computer conferencing to provide users with immediate access to help when they are cut off or are experiencing problems.

Finally, the reliability of a telecommunication system is affected by the reliability of any other systems with which it interconnects. For example, at Case-Western Reserve, the telecommunication system was dependent upon the paging system at the hospital to help find the doctor and establish a connection. The average response time of a doctor was "overlong" as a result of the hospital's inadequate paging system (Case-Western/Cleveland Telemedicine Project, Final Report, 1977).

8.4 Equipment Installation and Repair

Many projects report that the installation of equipment presented more problems than expected. There are relatively few individuals and/or companies who are highly experienced in installing interactive telecommunication equipment. Installation nearly always involves "debugging." Often, insufficient time and personnel are budgeted for this task. Debugging may be viewed as consisting of at least two phases. The first phase involves those problems which the installer or technical staff uncover. The second phase involves those

problems which are discovered only when users get their hands on the equipment (Lewis, 1977).

It is valuable to learn from the lessons of many projects which depended upon installation assistance from a company which was far away (Peoria, Cambridge Telemedicine Project, MRCTV, among others). A potential installer who will not be available to come back many times for repairs and debugging is not adequate.

Discussions with project managers who are satisfied with how their equipment works, reveal a common element: a first rate technician on-site or available on a regular basis (INTERACT, Massachusetts General Hospital, Nebraska Veterans Administration Hospital, Philadelphia Police Department, among others). Recruiting such a person is difficult under any circumstances. It is made more difficult if insufficient salary is budgeted, or if an agency's policy requires that the technical person be recruited internally from department staff (where the existing staff does not have experience with this type of equipment). When a project cannot have a full-time technician, or chooses not to, a reliable and available repair service is essential. Indeed, for one project (Department of Energy) repair service was an overriding factor in choosing among available systems, i.e., those concerned chose a somewhat more expensive system where repair service would be out of their hands and guaranteed, rather than a somewhat less inexpensive service where repair service would be more problematic.

8.4.1 Special problems in audio installation. Most projects which have had an audio component have experienced some degree of difficulty in achieving good audio. Audio problems are reported as more common than video and/or computer problems. The reasons for this appear to be:

1. Implementers generally place audio far down on the list of things to worry about. In most projects

which have an audio and a video component, greater and earlier attention is given to video.

2. Audio disruption affects the flow of communication more than video disruption. As a consequence, users notice bad audio very quickly.

3. There are several intrinsically difficult problems related to audio communication (e.g., feedback, background noise, unwanted "capturing" of the channel in a voice-switched system) which require careful attention in each application.

8.4.2 Unanticipated problems. Nearly every project has encountered some unanticipated problems. These have included, among others: late delivery of equipment; a local strike; unexpected disruption from dust which penetrated equipment. The likelihood of unanticipated problems requires that flexibility be built into the implementation effort, both in terms of personnel time and budget.

CHAPTER NINE

Users

9.1 Introduction

The projects we have studied are concerned with innovation. The innovation always involves the new use of a telecommunications service. Often, however, it involves much more: e.g., reorganization of the delivery of education, health care, or legal services. Consumers of the latter services are not necessarily users of the technology. In the Irvine Two-Way Cable Television Project, for example, the service consumers were users of the technology; in the Boston Nursing Homes Telemedicine Experiment they were not. We shall refer to providers and clients in these situations, reserving the term users for those directly served by the telecommunications system.

Sometimes existing service-delivery organizations have to be redesigned; sometimes new organizational entities have to be formed. In these cases, individuals who work in the user-system may be affected by, or capable of affecting, the innovation even though they are not necessarily users of the technology.

Benefits overall do not imply benefits for all. There are almost certain to be those who will be threatened by the innovation or who would expect more from an excluded alternative. Some may be powerless and irrelevant. Some may be powerless, but relevant on ethical grounds. Others may be in a position, directly or indirectly, actively or passively,

now or later to sabotage the new service. Unless a successful appeal can be made to their altruism, unless they can be co-opted, unless they are bought off, or unless they are kicked out, there will be trouble. Nor should one underestimate the amount of time it takes for those who are favorably inclined to implement the financial changes which may later be necessary to the survival of the project.

9.2 Predisposition to Use the Telecommunications System.

People will not use a service if they do not know of its existence. They are unlikely to choose to do so unless they expect the experience to be satisfactory. In this section, we shall consider the roles of publicity, initial experience, and expectations of technical quality.

9.2.1 Publicity. When a telecommunications component is introduced into a redesigned public service, it is very likely that prospective users will know about it.[8] Lack of publicity has, however, frequently been proposed as an important factor in the lack of success of teleconferencing projects. Nevertheless, an attractive service may be successful in generating much of its publicity by word of mouth; high awareness of a service may be a consequence as well as a cause of success. Since causality is bi-directional, past failures may too often have been blamed on poor publicity. It was rarely cast in the role of culprit in our survey.

The purposes of publicity are: (1) to attract potential users to a demonstration or persuade them to try a system once; (2) to make them receptive if its use is suggested by others, and; (3) to provide them with such

[8]This is not necessarily true of prospective clients for the public service, as is shown by the need to publicize the high school equivalency courses to potential students in Spartanburg.

information as is necessary to find out how to try or to use the system. This must be done without creating false expectations. To achieve the first two it may be necessary to raise the value that prospective users place on the goals the service is intended to serve: e.g., responsiveness, avoidance of delay, better coordination, and so on.

9.2.2 Initial experience. Projects are particularly vulnerable to unfortunate early experience (Champness, 1972). Disappointed users are unlikely to recommend a system to others and they are less likely to return themselves. At a later stage, within the context of successful prior experience, occasional difficulties are less serious. Yet it is at the start that problems are more likely. Technical malfunctions are more probable; users (and, if relevant, operators) may make mistakes; and there is less understanding of when it is appropriate to use the system.

9.2.3 Expectations regarding technical performance. Inexperienced users may be unable to distinguish between technical malfunctions and unskilled use of a system. They will not know what quality to expect, so they may assume that what they experience on a bad day is typical. Their expectations may be unrealistically high as, for example, when they expect broadcast standard television in a video-conference.

These problems can be aggravated when part of the telecommunication system is outside the direct control of the project team and it introduces uncertainty into the overall technical performance. Examples are telephone line connections between audio-conferencing terminals and computer networks which give certain customers higher priority in the use of available computer time.

The really troublesome problems in this area arise when the project team itself does not know what technical performance to anticipate. This is not as unusual as one

might expect. It is generally associated with new technology, subcontracted technical services, and lack of time for pilot operations as a result of delay in delivery of the equipment.

9.3 Arranging to Use the System

The process which must take place between the decision to use the system and actually doing so varies considerably from one project to another. Nevertheless, there are some relatively common features which deserve attention: availability of the other parties; availability of the system; and necessary preparations.

9.3.1 Availability of the other parties. A characteristic of all "real-time" person-to-person telecommunications systems is that there needs to be at least one person at the other end(s). If the terminal equipment is not where the others happen to be, the use must be arranged in advance. Scheduling may also be necessary to avoid interrupting other important activities. Conversely, systems which are used on-demand by one party will interrupt the ongoing work of at least one other.

Prearrangement is relatively straightforward for uses which are arranged according to a fixed schedule--e.g., teaching applications and routine teleconferences. Nor does it seem to have been regarded as troublesome when the alternative would have been an in-person business meeting. There have, however, been cases of resentment when the need to be available at short notice has been disruptive. This has happened in some telemedicine projects and typically it is the more senior person who is interrupted. There is also a suggestion that within a corporate context junior staff may be reluctant to initiate communication with senior staff over a new system.

9.3.2 Availability of the telecommunication system. Availability is a matter of how easy it is to have the use of

the system when one wants it. In contrast to accessibility (discussed in section 8.1), low availability does not often seem to have been associated with users' rejection of a system. It is more a problem of high acceptance (for example, in the Phoenix Criminal Justice System).

A few difficulties have arisen with satellites, as when their availability has constrained usage to an inflexible weekly schedule. A final point to note is that the procedures set up to check availability and confirm reservations may themselves constitute a barrier to using the system.

9.3.3 Set-up. In some situations, users may have to become involved in time-consuming procedures prior to using the telecommunication system. A good example is a nurse having to prepare a patient for a "teleconsult." Some of these obstacles may be removable, at least in part. Others must be taken into account in advance consideration of usage and economics.

In addition, some applications of interactive telecommunications require time to set up equipment. This is particularly the case when there is a video component to the system (which in some cases can require an hour to set up). Set-up should be started before the user is scheduled to begin a conference or training session, not at the beginning of scheduled usage.

9.4 Training

Two quite different types of training may be required in a project: training in the use of the telecommunication system and training for a new organizational role. In the Boston Nursing Home Telemedicine Experiment, on the one hand, training of nurse practitioners for their new role was a major undertaking requiring almost a year, but virtually no training was necessary in the use of the technology. In the Reading Project, on the other hand, important subsets of

users needed to develop significant additional skills in operating the system. The following remarks pertain to training in use of the technology.

Beliefs about practical and acceptable limits on training will have influenced the technical design of a system. Thus, the need for users to operate controls in Picturephone® Meeting Service is minimized. This accords with a strong school of thought that such systems should be as simple to use as possible. In Irvine, California and in the Reading Project, a different philosophy prevailed. In these two-way television systems users had decidedly non-trivial tasks to perform. (This makes good sense: one can assume that school children and retired people have the time and desire to accept the challenge.)

In some projects, training has to reflect a greater need for skills on the part of some users, than of others. (The travelling paramedics in the STARPAHC Project provide an example.) In others, for example computer conferencing, the need is more symmetrical. Notice that sometimes a certain level of instruction will be needed by those who do not get to use the system (e.g., NASA trained secretaries in making arrangements for teleconferences; in Phoenix, wardens needed instruction in procedures necessary to allow a prisoner to communicate privately with the public defender).

Despite the variety of projects in this field, a few general statements do stand out. First, even if a system is very simple to operate, there is generally a value in allowing intended users to try it out on a demonstration basis, when mistakes do not matter, before using it "for real." Second, whether instructions are written or presented in-person, there is agreement that, where possible, they should be offered on a colleague-to-colleague basis, rather than "handed down" by the specialists. There have been occasions when this desideratum has not been met. A third

and related observation is that peer training seems to work well in a variety of projects. Finally, there will be a period of time after a user knows how to use a system properly, before he or she is comfortable with it. Continuing encouragement and reinforcement is necessary, or at least desirable, during this period, in which the novelty of the medium may distract the user.

9.5 Resistance to Innovation

A technical innovation may be interpreted by users in a variety of ways. The user may feel:

1. "This is something that can help me do what I want to do."
2. "This is something that will replace me."
3. "This is something that will upset my normal routine."

A few of the reasons which lead people to feel (1), (2), or (3) are discussed below.

9.5.1 Need for associated changes. As noted in the preceding chapter, the introduction of a new telecommunication system may bring with it the need for change in the operation and structure of a user organization. There is ample evidence that individuals resist organizational change.

Change may also be required in the way that people conduct their work. It has been observed, for instance, that greater discipline is necessary in teleconferences than in face-to-face meetings. More attention needs to be paid to the precirculation of papers, for example, and to estimating how long the "meeting" will last.

There may also be a need for change in related payment systems. Although, in the projects we examined, it was very much the exception that payment had to be made on a per use basis, this issue does loom over the field. Note the need to arrange for reimbursement of physician-extenders' services at the end of the experimental phase of the Boston Nursing Home

Telemedicine Project (in this case payment for the service supported by the telecommunication service, rather than the latter itself). An example, directly related to the use of the telecommuncation system, arises with Picturephone® Meeting Service. Problems will arise for users if an employer's accounting system does not easily accommodate its charges. Even when use of telecommunications option would be economical, it may seem extravagant if it is implicitly compared with the cost of a telephone call.

9.5.2 Pressures of demand. A new telecommunication service, intended to increase or extend a social service (e.g., health care) to those previously poorly served, may increase the pressure of demand on professionals without increasing resources essential in meeting it. If a professional is busy all the time and knows that the new telecommunication service will not save time, why should he or she bother with it? There may indeed be benefits attached to the new telecommunication service (e.g., reduced operating costs), but these are typically benefits for the institution, not the professional.

A related phenomenon occurs with person-to-person on-demand telecommunication services. As noted above, if it is available on-demand for one party, it may well interrupt the ongoing work of another person. This is not a new problem; it occurs with the telephone. However, whereas a business person may have a secretary who screens or postpones telephone communication, the users of new telecommunication services may reject the service entirely or complain until the appropriate manager removes it.

9.5.3 Loss of valued side benefits. Especially for teleconferencing systems conceived as substitutes for long-distance travel, it is frequently remarked that prospective users may be reluctant to forego pleasures they derive from business travel to an attractive distant location.

In our opinion, this issue is probably emphasized unduly (e.g., because much travel is to locations which offer no personal attraction and because much more is involved than direct substitution for business travel). However, there is another type of possible loss which has received little attention: in-person communication may sometimes be valued intrinsically, while telecommunication would not be (i.e., people may sometimes derive pleasure from the in-person communication process, as well as value it as a means to some other end).

9.5.4 Reduction in autonomy and status. To teach via television makes a teacher more open to evaluation by others. In some cases, nurses fear that a telemedicine system (or the protocols associated with it) will lead to more frequent checking of their way of working by doctors. In general, by offering an additional means of communication, a telecommunication system brings with it the possibility of reducing the autonomy of those who may have derived some benefits from traditional barriers to communication. Associated with actual or perceived loss in autonomy may be an actual or perceived drop in status.

9.5.5 Possible infringement of professional or legal standards. Prospective users have sometimes been concerned that use of a telecommunications system would, in certain situations, be an infringement of some professional standard or legal requirement. Examples are patients' rights to privacy and an accused's right to "confront" hostile witnesses. The other side of this coin is when a change in rules creates a problem to which telecommunication may provide part of the solution. An example is the court ruling in Philadelphia mandating a shorter time period between arrest and appearance before a judge--a problem which the police video telephone helped to solve.

9.5.6 Neglect of more pressing problems. An individual may be keenly aware of much more pressing problems in his or her work environment than those at which the new telecommunications service is directed. The new service may be resented as diverting attention and/or funds away from the former.

These problems are mitigated, to some degree, if the professional can be required to use the system; if he or she can treat or serve more people and thereby make more money by using the system; or if it relieves the professional of a travel assignment which he or she does not want. However, these problems remain a serious barrier to the successful implementation of a telecommunication service for professionals.

9.6 The User Environment

Certain features of the users' organization may affect the prospects for innovation.

9.6.1 Morale. We have come across two projects in which morale in the user organization was low when the new telecommunications system was introduced. Neither succeeded.

9.6.2 Cultural and ethnic barriers. In a few projects, communication problems were associated with cultural or ethnic differences. In all cases they seem to have been overcome.

9.6.3 Turnover. The higher the turnover of the prospective user population, the more continuing will be the need for publicity and training, though it is possible that both these may be provided on a peer basis by users who remain.

9.6.4 Exogenous changes. Projects are particularly susceptible to changes in their user environment. Such changes may have a positive impact, though more often they seem to have a negative one: removing the "need" for the

service or removing from the scene someone whose support is important to the innovation. They may also damage the research design.

The problem is inescapable. Field trials and demonstration projects are, by definition, undertaken in the "real world." Change is characteristic of the real world. The longer the project lasts, the greater the chance of a major change occurring. In some cases, fortunately, the longer a project lasts, the more it has become robust against potentially adverse changes and able to profit from potentially favorable ones.

9.7 Overcoming Resistance to Innovation

In concentrating upon threatening consequences, the preceding sections have painted a rather gloomy picture. Many of the effects also have positive counterparts which may reinforce adoption of a new system. The associated changes which need to be made may remove irritants. The innovation may bring its own valuable side benefits for individual users. It may increase autonomy and/or raise status. It may improve job security by enabling individuals to make greater contributions to organizational objectives. It may make it easier to meet professional and legal standards. And the innovation may be seen as an attempt to tackle fundamental problems.

Moreover, some of the threats or losses may be imaginary. Thus, after Picturephone® was used in Phoenix for the arraignment of defendants who were pleading not guilty, some defendants complained about not being able to put their own story to the judge. This opportunity would not, however, have been available if the defendants were pleading not guilty at this stage in the traditional manner.

In dealing with these issues, it will matter whether use of a system is voluntary or mandated. A policeman can be told by his superior to use a telecommunication system for a

given purpose, whereas AT&T has to market their teleconferencing services. However, even when a user group is required to use the equipment, resistance can manifest itself through complaints and poor work that is attributed to the telecommunication system.

Some projects have exhibited a sensitive approach in dealing with resistance to innovation. Care was taken to anticipate predictable problems of this kind and to sense others as they emerged (e.g., by use of sensitive personnel in the field, by allocating time for "feeling around," by use of sophisticated incident-reporting systems). If users are treated as partners in the process of innovation, they or their representatives may play a useful part in overcoming the problems.

In one project which was treated as a partnership we noticed that users developed the self-image of pioneers and use of the telecommunication system was encouraged for purposes which were personally rewarding as well as for those which were immediately "useful." The way prospective users are involved in the design and management of the innovation, and their relationship with the project team, can be expected to affect the ease with which resistance is overcome. These topics, among others, will be considered in the following chapter.

CHAPTER TEN

Management of the Implementation Process

This chapter treats: the composition of the implementation team; communication among team members; how and when to involve users in implementation; issues related to payment for the system and services provided through the system; the transition from field trial to ongoing operation; and the length of time required to implement a project.

10.1 Composition of the Implementation Team

In one sense, it is not helpful to say that the quality of the implementation team will affect the outcome of a project.* "Quality" is an intangible concept, whereas full time vs. part time or paid vs. volunteer are tangible categories which can be researched, reported, and serve as criteria in putting together a team. Yet the tangible categories, to be discussed subsequently, are merely threads which can divert attention from the whole cloth of quality. Further, judgments about quality are inevitably subjective. What follows are some guidelines which may help in the process of assembling a good team, but they should not be taken as strict criteria for selection.

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*Often, a team responsible for implementation is eventually superseded by a team responsible for managing an ongoing service. The changeover may be a gradual process in some cases. In projects which evolve over a long period, the same team may have both responsibilities.

10.1.1 Insiders vs. outsiders. An issue of significance to most of the projects we examined is the composition and ratio of insiders to outsiders on the implementation team. The implementation team, as the term is used here, is a broad category which includes project managers, trainers, technicians, researchers and evaluators (in some situations), and others who participate in getting a project up and going.

In some instances, the implementation team has been predominantly internal (e.g., the Philadelphia Police Department); in other instances, the implementation team consisted largely of people who were not part of the intended user group (e.g., the Phoenix Criminal Justice System). Where the intended user group predominates on the implementation team, outsiders are often used for installation of equipment and technical consultation. Most of these applications are intended for service delivery only, with little or no research component. Where the intended user group does not predominate on the implementation team, an outside university, government agency, or manufacturer is most often in control for purposes of field testing or research. Most of these applications intend service delivery only as a means to an end (e.g., a research question) or a possible byproduct of a field test (i.e., if the field test proves successful).

There is no evidence which suggests that a project will be more successful with any particular ratio of insiders to outsiders. In any case, the composition of a team and ratio of insiders to outsiders often change over time. In one typical pattern, outsiders predominate at the very start; insiders join the team during the design stage; and outsiders withdraw as the project passes from trial or demonstration status into operational status. Another common pattern is: insiders only at the very start; outsiders (e.g., tele-

communications consultants) and more insiders join in the design stage; and finally, outsiders and some insiders leave as the project becomes established.

Some potential problems with outsiders are: they may not know the particular situation where the project is being implemented; they may not be on site when they are needed; they may not be concerned with day-to-day problems; and some users may resent their presence. Some potential problems with insiders are: they may not be knowledgeable about the telecommunication system being installed; they may not know the broader picture of how and why telecommunications has worked/not worked elsewhere; and they may be unable or unwilling to negotiate with other agencies or groups who are involved in the project. Recognition that one or more of these problems are likely to be present in a particular situation should influence the choice of an insider or outsider to perform the task(s). For example, when an outside agency controls a project, it is valuable for an inside, local person to have a visible, active role in managing on site. This is particularly important if the project director is an outside researcher who may not have the time, skills, or inclination to become involved in day-to-day problems on site.

10.1.2 Full-time vs. part-time personnel. Discussions with project directors indicate a preference for full-time personnel, where possible.

10.1.3 Other responsibilities of project personnel. When part or all of the staff is non-salaried, borrowed from an outside agency, or shared with another group, it is important to know that they are willing and able to commit the energy and attention necessary to do a good job. Many projects have experienced problems because a staff member was not paid by project funds and had many responsibilities

outside the project (for the institution or agency which was paying his or her salary).

10.1.4 Working with engineers. In some situations, there is a conflict between engineering consultants/technical staff and planners/manager/users. The planner, manager and user often do not have sufficient technical competence to argue with an engineer about the design or use of a system. The engineer's position may be based on personal preference or convenience, not technical feasibility. On the other side, a manager can force an engineer into a situation that compromises technical soundness. There is no simple solution to this. It does point out the importance of a good working relationship between engineer and manager, and flexibility by both. In addition, there can be substantial value in having access to engineering advice which is independent of the company providing a transmission service (e.g., a cable television company, a telephone company or installers of microwave equipment).

10.2 Communication Within the Implementation Team

Poor communication among components of the implementation team has been associated with many difficulties. It has led to poor coordination of tasks, inattention to user problems, and in some cases, mistrust.

10.2.1 Recognizing different styles of work. A useful first step in developing communication links is to recognize variations in styles of work among components of the team. It is better to accommodate work styles, building communication links around them, than to impose procedures which are likely to be resisted. For example, lengthy report writing is resisted by some groups.

10.2.2 Trust, inspiration, and heroes. The communication among team members should foster trust and teamwork. The social goals of the project (or simply the knowledge by a team member that he or she is participating in a pioneering

activity) can be a source of inspiration. And a project hero or product champion, if viewed as such by team members, can be highly beneficial to a project. All of these values reflect an awareness that implementing a telecommunication application is a process of human interaction. This awareness has been missing from some projects.

10.2.3 Communication flow. Communication within a project team can flow in three directions: down (director to staff); up (staff to director); and across (among staff, among managers, etc.). All three are important. Nearly all projects have mechanisms for flow in a downward direction (e.g., printed memos, guidelines, and procedures). Most have mechanisms for communication to flow across (e.g., informal talk among peers), but relatively few have had ways for communication to flow upward. The latter is crucial for building trust and learning about problems before they get out of hand. One mechanism for creating such communication is a regular, open staff meeting where problems can be aired (Reading, Pennsylvania). It is also possible to encourage such communication if the boss visits with individual staff members and asks "What are the problems?"

The communication flow between management and staff is made more difficult if the director or parts of the management team are not on site with the staff. In such cases, frequent visits by managers are important, as is access to management-at-a-distance by phone calls from project staff.

10.2.4 Monitoring problems. It is not sufficient to wait for problems to arise in full bloom. The implementation team should actively look for emerging problems. Three ways to do this are: (1) employ personnel in the field who are sensitive to emerging problems; (2) allocate specific time for staff and management to "feel around" for such problems,

and; (3) use sophisticated incident reporting techniques (in the STARPAHC Project these are called "trouble reports"). The systematic reporting of problems enables management to distinguish chronic problems from occasional difficulties and helps prevent problems from slipping through the cracks simply because they do not cause a major crisis each time they occur.

10.2.5 The language and length of memos and reports. Memos and guidelines by project management to staff should be written in clear, concise language. In some projects which we examined, this was not the case. As a result, on-site staff did not always understand the project objectives. At the same time, reports which the staff are required to submit may be resisted (or not written at all) if the length and detail required are unreasonable and if they are not allocated specific time to do the report writing. Particularly for those whose careers are built on report and research writing, it is useful to bear in mind that many workers find writing of any kind to be difficult and tedious.

10.3 Paying for the Service

Problems related to payment for the telecommunication service by a governmental or social service agency are less likely during a field trial or demonstration phase. During this period, per-use payment is generally not an issue. Typically, an agency or agencies have agreed to pay the bill for a period of time and issues related to future payment for the service are ignored by the implementation team. This is a mistake unless it is known for certain that the service will not continue after the field trial or demonstration phase.

Payment for service is a relevant issue, from day one, for any application which intends to continue operating beyond the end of its trial or demonstration status, or to leave open this possibility. The problems of finding a

means of covering costs, discussed below, requires serious and early attention.

A common problem is to find an existing budget category within an agency or institution which can pay for the service. Alternatively, a budget category must be created. For example, if a telecommunication service is saving a hospital or government agency travel time and money, can its travel budget be used to pay for the telecommunication service? Often, it cannot and this is a major stumbling block. To overcome it, a great deal of negotiating may be necessary.

Another problem arises when one agency agrees to pay for the field trial and a different agency is called upon to pay for the operational service. If the project becomes labeled as belonging to agency A (because it sponsored the field trial), agency B may be reluctant to pick up the cost later, for reasons of jealousy or fear that it will not have sufficient control over the system.

Many projects are supported by a group of independent institutions (e.g., hospitals) with some form of affiliation that is not binding. They share the costs of the telecommunication service. Typically, each institution (there may be ten or fifteen participating) must be convinced each year that the system is valuable to them. The work involved in re-selling the system each year can be enormous. Moreover, the entire system may be placed in jeopardy if one or two institutions pull out.

In dealing with these problems it is important to start early in the project. If possible, one should work to make payment for the service a regular budget item for the relevant agency. If the agency or group that must ultimately pay for the service is different from the agency or group paying for the field trial, one should involve the former from the beginning (e.g., have it participate on an advisory board).

In general, it is necessary to discover how a service becomes permanent within the bureaucracy that is relevant to a project and work to meet those standards. For example, in the STARPAHC Project it was necessary that each piece of equipment be assigned a serial number from the U.S. Public Health Service in order for it to become theirs after the demonstration period, and thus fall within standard budget categories which could pay for repairs and servicing.

10.4 The Transition from Field Trial to Ongoing Operation

In many demonstration projects, there is no clear or stated intent at the beginning of the project to continue after the demonstration period, but such an intent emerges later. In cases where this has occurred, the transition process has been very difficult.

In making a transition from demonstration project to ongoing operation, it helps if: (1) relevant local agencies are involved from the beginning; (2) some local funding is involved from the beginning, and; (3) users are trained to become the trainers of future users. All of these initiatives are weakened if they are begun a year or two into the project.

10.4.1 Changing the source of funding. Projects which rely on federal money for the demonstration or field trial find that there are fewer sources of federal money for ongoing operations. As a consequence, the project may attempt to create new uses or programs for the system in order to obtain "demonstration" money for the new use. This is a common practice. The problem is that such a practice can create an ever increasing demand on the system without a similar increase in resources. New money, intended for a new use, must pay for the new use and the old uses for the system. As a consequence, resources are spread too thin.

An alternative to the above is for a project with initial funding from a federal source to subsequently ask

the state, city or private institution to pay (or, to ask individual users). One problem in such a transition was discussed in section 10.3 (i.e., where agency B doesn't want to pick up the tab for a system which everyone regards as belonging to agency A). In addition, the new agency or user who is now being asked to pay for the service will have to feel the value of the service. Value is a tricky issue. If users have paid part of the cost of the project from the beginning, it appears that they are more likely to pick up the full cost after the transition phase.

Especially where expensive equipment is used, the costs which are recovered should presumably include a component for depreciation. It is somewhat disturbing that this appears to be unusual.

10.4.2 Preparing for user takeover. The operation of a system cannot simply be "handed over" to the user group at a set date. The new management team must be trained during the demonstration or field trial period. They must learn all aspects of the system (technical, financial, organizational) that they will need to know before they are given the "keys" to the system. This suggestion would appear to be common sense, and it is. However, a host of pressures and time constraints on a project team can easily lead them to ignore these common sense requirements of a transition.

10.5 How Long for Implementation?

In some instances, implementation was viewed only as a matter of installing equipment. In most cases, however, ties must be developed with user organizations, users must be trained, and many other activities related to the service are necessary. These needs must be taken into account before implementation commences.

There is no simple formula for calculating how long the implementation phase will require. However, in many projects, managers reported that they calculated on the short

side, or were forced into a short implementation phase by the requirements of their funding sources.

CHAPTER ELEVEN

Conclusion

A major assumption underlying our study has received widespread and strong support from practitioners in the field, both in interviews and as reactions to an earlier working paper: problems of implementation seem generally to have been underestimated and they have received inadequate attention in the telecommunications literature.

However, drawing firm conclusions why the implementation of some projects succeeded and that of other projects failed is difficult and dangerous. One cannot assume that correlates of success are causes; they may be effects. Even when one can be sure that one is dealing with a cause, it may be that the problem in question had multiple causes--that this was the last straw that broke the camel's back. Nevertheless, we believe that several useful conclusions can be presented.

11.1 Nature of the Innovation

Just what is the nature of the innovation that is being attempted? The importance of being as clear as possible about this at the start of a project stands out very clearly. In all cases one is attempting more than the introduction of a satisfactorily functioning technology into an organization. Minimally, one seeks, in addition, to cause some potential users to change their behavior. Often the innovation is much more fundamental: a major change in organizational structure

and operations, which incorporates among its elements the use of a new telecommunication system.

Organizational redesign on a radical scale is generally acknowledged to be a difficult and risky business. It calls for partnership between those knowledgeable about the type of organization in question and those knowledgeable about telecommunications. There are obvious dangers in seeing the major aspect as being telecommunication, rather than the larger innovation which telecommunication makes possible.

If the money and people can be made available, it may be easier to create a wholly new organization, rather than remodel an existing one. And certainly we have been struck by the fact that many of the successful projects among those we studied did create new organizations.

11.2 Complications Particular to Field Trials and Demonstration Projects

In most of the field trials and demonstration projects we examined, there had generally been an implicit assumption that the new service would be used. What was thought to be at issue was the value of such in relation to costs. This assumption is unwarranted. It must be made explicit and subjected to critical scrutiny.

The value of an evolutionary approach, in which the service is gradually brought up to a necessary standard cannot be overestimated. Such an approach may be difficult given the fixed timescale and financing characteristics of federally funded research and demonstration projects. Agencies might obtain better value for money if they were to fund relatively more pilot projects of a modest kind. Successful pilots could then become candidates for proper field trials or demonstration projects.

11.3 Ingredients for Success

The avoidance or solution of many of the problems which have been discussed in this report is only a matter of common

sense. Is common sense really so uncommon? Probably not. It seems more reasonable to conclude that there are very many things that can go wrong, far more than has generally been appreciated, and that inevitably some danger points receive insufficient attention. In addition, reality generally demands compromises. Maybe the space available for some terminal devices is less than ideal, but maybe it is the only space available.

It is not sufficient to know about the difficulties which quite possibly may arise. They require close attention together with sufficient time, money and personnel to allow them to be overcome.

Other difficulties may be less obvious in advance, but experiences of others can now provide a warning. Already in this chapter we have repeated earlier points about appreciating the nature of the target innovation and the danger of implicitly assuming that a new system will be used. A few other useful generalizations appear to stand out.

One such conclusion is that a surprisingly large number of actor groups may be involved, each with its own set of interests. By no means will they all be potential users of the new system. It can be dangerous not to perceive a relevant interest group in sufficient time. It can also be painfully time-consuming to give all of them the time they require.

Associated with the multiplicity of actor groups is the fact that there are likely to be significant changes in the environment of the new system during the lifetime of a project. They may be beneficial, but they may also be threatening. One must expect the unexpected and one must have the flexibility to adapt to it. Funds and personnel, for example, should be assigned in such a way as to permit adjustment during the process of implementation.

Problems also arise from the novelty of the media we have studied. First, users may confuse message with medium. A physician may write off interactive television in reaction to a particular encounter while using it. Second, users initially will not know what technical performance to expect. It may be difficult for them to distinguish results of equipment which is poorly selected, installed or operated from intrinsic qualities of the medium. The problem is compounded if the implementation team does not know what standards to expect.

Implementation is not an activity which can justifiably be separated from concept development, technical design, project planning and the characteristics of the related organizational system. All the elements at work in a situation must be in a process of mutual adjustment: the telecommunication system must "find a home" within a social and organizational context. The implementer must (1) understand the context; (2) be prepared to mold the innovation to the situation; and (3) work hard to make the situation receptive to the innovation.

There is no one style of implementation that is superior in all situations. We have come across considerable differences in style. In some cases a "strong boss" has pushed an innovation with considerable success; in other cases this approach has failed. There have been examples of successes in which users were treated as fully participating partners, in which they were treated to a "take it or leave it" approach, in which they were ordered to use the new system, and in which they were astutely manipulated. Style, like many other features of implementation, must be viewed in relation to the context in which it is applied.

One set of features does seem to hold across all successful projects:

- o understanding of individual users
- o understanding of the organizational or community context*
- o understanding of the technology
- o understanding of the properties of the media concerned.

We cannot argue that these are necessary preconditions to success from the fact that they are present among successful projects. They may be incidental by-products of success. It does, however, appear eminently plausible to conclude that any implementation team should incorporate such understanding or have the ability to develop it.

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*An exception is provided by public conferencing systems which must work across a wide variety of organizational contexts.

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